Computer Sciences Corporation

CSC/SD-85/6738

GODDARD TRAJECTORY DETERMINATION SYSTEM (GTDS) USER'S GUIDE

REVISION 2

CSC

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland

Under

CONTRACT NAS 5-27888
Task Assignment 483

DECEMBER 1987

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FLIGHT DYNAMICS DIVISION	DOCUMENT CHANGE NOTICE (DCN)	DCN NUMBER DCN 2 DATE 6-23-89 CHANGE REQUEST REFERENCE
ORIGINATOR NAME Donald Squier	ORGANIZATION Computer Sciences Corporation	TELEPHONE (301) 794-1111
DOCUMENT TITLE Goddard Trajectory Determination System (GTDS) User's Guide (Revision 2 - Update 2)		DOCUMENT NUMBER CSC/SD-85/6738UD2

PAGES CHANGED (INCLUDING DELETIONS)

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4-274
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H-63
H-63a
I-1 - I-12

CONTINUED ☐

CMO SIGNATURE [signature] DATE 9/12/89

CSC/OSSO/CMO/019(5/85)

FLIGHT DYNAMICS DIVISION	DOCUMENT CHANGE NOTICE (DCN)	DCN NUMBER DCN 1 DATE 6-30-88 CHANGE REQUEST REFERENCE
ORIGINATOR NAME Donald Squier	ORGANIZATION Computer Sciences Corporation	TELEPHONE (301) 794-1111
DOCUMENT TITLE Goddard Trajectory Determination System (GTDS) User's Guide (Revision 2 - Update 1)		DOCUMENT NUMBER CSC/SD-85/6738UD1

PAGES CHANGED (INCLUDING DELETIONS)

3-108
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CONTINUED ☐

CMO SIGNATURE	DATE
R. Ferrero	7/15/88

CSC/OSSO/CMO/019(5/85)

CSC/SD-85/6738UD2

GODDARD TRAJECTORY DETERMINATION SYSTEM (GTDS)

USER'S GUIDE

REVISION 2 - UPDATE 2

Prepared for

GODDARD SPACE FLIGHT CENTER

By

COMPUTER SCIENCES CORPORATION

Under

Contract NAS 5-31500
Task Assignment 59 337

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PREFACE

This document is the second revision of the Goddard Trajectory Determination System (GTDS) User's Guide. It supersedes the previous issue, document number CSC/SD-85/6738. This revision reflects changes stemming from the replacement of the Goddard Space Flight Center (GSFC) Flight Dynamics Facility (FDF) IBM S/360 computer with NAS AS/8040 computers. Software upgrades made to GTDS since the previous version of the document was issued are also reflected whenever those changes affect user input or system output. This revision also includes enhancements made for TCOPS Release 3.

ABSTRACT

This user's guide describes the card input needed to run the Goddard Trajectory Determination System (GTDS). The description encompasses GTDS capabilities, the input cards [including the Flight Dynamics Facility (FDF) Operating System/Virtual Storage 2 (OS/VS2) job control language (JCL)] that must be supplied to invoke those capabilities and the printer reports that result from GTDS executions.

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SECTION 1 - INTRODUCTION

The Goddard Trajectory Determination System (GTDS) is a collection of related computer programs that provides operational support for Earth, lunar, and interplanetary missions and serves as a research and development tool. This user's guide enables GTDS users to prepare, with minimum effort, the data necessary for executing any GTDS program. This guide is also a compendium of GTDS program capabilities.

GTDS fulfills the orbit determination and tracking data validation functions of the Trajectory Computation and Orbital Products System (TCOPS), which collects, stores, and processes metric tracking data for purposes of spacecraft-orbit product data generation. TCOPS is implemented on the National Advanced Systems (NAS) AS/8040 computers of the Goddard Space Flight Center (GSFC) Flight Dynamics Facility (FDF).

This user's guide contains Sections 1 through 5 and Appendixes A through H.

1.1 MAJOR CAPABILITIES

GTDS capabilities cover wide areas of computational requirements for mission support and mission analysis. The system is subdivided as follows:

- Ephemeris Generation (EPHEM) Program
- Differential Correction (DC) Program
- Filter (FILTER) Program (Not currently available)
- Early Orbit Determination (EARLYORB) Program
- Data Simulation (DATASIM) Program
- Error Analysis (ANALYSIS) Program
- Ephemeris Comparison (COMPARE) Program

- Data Management (DATAMGT) Program
- Permanent File Report Generation (FILERPT) Program
- Thrust Parameter Modeling (THMODEL) Program

The Ephemeris Generationd Program propagates the vehicle state and state partial derivatives from prescribed initial conditions over a given timespan. To meet varying precision and efficiency requirements, several orbital theories are provided, ranging from a first-order analytic theory to a high-precision Cowell numerical integration. The state transition matrix can also be generated, either by analytic approximation or by precision numerical integration of the variational equations. Output is generated on an online printer with the spacecraft state (position and velocity) referenced to the indicated central body. The output can optionally include the state vectors related to specified noncentral bodies. Satellite ephemeris files can also be optionally generated for subsequent use by GTDS and/or other systems that need satellite ephemeris data.

The DC Program estimates the values of a set of parameters, called solve-for variables, in a mathematical model of spacecraft motion. These parameters are determined so as to minimize (in a Bayesian weighted least squares sense) the sum of the squares of the differences between computed and observed trajectory data, while simultaneously constraining the solve-for variables to satisfy a priori estimates to within a specified uncertainty. Both first- and second-order statistics (i.e., mean and covariance matrix) are determined for the estimated parameters.

The FILTER Program is not currently supported in the operational version of GTDS.

The EARLYORB Program is designed to calculate an initial estimate of an Earth orbit when there is no a priori estimate available to start a DC. The EARLYORB Program uses several selected station observations to rapidly approximate an initial estimate (starting vector) for the DC Program. As few as six observation measurements can be used to calculate the estimate of the spacecraft state.

The Data Simulation Program computes, at a specified frequency, simulated observations of an Earth-centered or lunar-centered satellite for given sets of tracking stations and observation intervals. Optionally, random and bias errors can be applied to the observations. Observations can also be modified to account for the effects of atmospheric refraction, antenna mount errors, transponder delays, and light time delays. Observation files resulting from a DATASIM Program run can be used as input for simulations of GTDS mission support operations and for determining station tracking schedules.

The ANALYSIS Program provides the capability to determine satellite state uncertainties about a given orbit as a function of epoch state uncertainty and observation data uncertainties for a given station-dependent tracking schedule. The ANALYSIS Program provides for observation types modeled in the DC Program, with design flexibility to provide for modeling of other observation types as the program is expanded.

The COMPARE Program compares two ephemerides that are input in the ORB1, EPHEM, or ORBIT File format. The comparison can be specified optionally over a particular arc or over the arc of overlap between the ephemerides. The radial, along-track, and cross-track differences or the geodetic

latitudes, longitudes, and spheroid heights of the position vectors are output in tabular form to the printer. Optionally, printer plots of these differences can also be produced. The COMPARE Program may also be used to merge two ephemerides in the EPHEM File format. The two ephemerides being merged must be of the same satellite and must have an overlapping arc. The merged ephemeris joins the two ephemerides at the time at which the difference between the position vectors of the two ephemerides is at a minimum.

The primary function of the DATAMGT Program is to retrieve data from the GTDS permanent online data base to create temporary working files of data to be used by other programs in GTDS. In performing this function, the DATAMGT Program operates as a part of the program that will use the working working files. The DATAMGT Program may also be used to create working files for a future program execution. In this function, called a data management run, the program operates as a standalone program.

The FILERPT Program produces reports describing the data and models existing in the GTDS permanent online data base and Solar/Lunar/Planetary (SLP) Ephemeris Files. At the user's option, summary and/or complete reports can be obtained from each file. Information concerning observations, station positions, astrodynamic constants, potential fields, integration coefficients, and other data files is obtainable.

The THMODEL Program provides the capability of estimating thrust parameters for a short-term maneuver [firing of the upper stages of an expendable launch vehicle (ELV)]. The program outputs its result to the GTDS flight section file (FSF), which will be used as input to the EPHEM Program for orbit propagation through burns (invoked by the keyword BURNFSF).

The execution of a single GTDS program will satisfy most operational orbit determination requirements. Users involved in mission support, mission analysis, and research and development activities may, however, encounter the need to exercise GTDS programs in series, using output from one GTDS program as input to a succeeding GTDS program. To satisfy the more sophisticated needs of such users, the various programs can be executed in any sequence.

When executing any of the GTDS programs, files of program results may be generated and saved for later use external to GTDS or for subsequent use by another GTDS program. These data files often contain satellite elements obtained from DC Program executions for later use as initial elements in GTDS DC or EPHEM Program runs. Several types of satellite ephemeris files can also be generated by these two GTDS programs. These ephemeris files are widely used outside of GTDS by systems that need satellite ephemeris information.

The GTDS programs can be executed in either a batch mode or an interactive mode. In the batch mode, card image input is submitted to the computer, which performs all GTDS processing as a background job and provides printed output at the conclusion of the job. In the interactive mode, input may be adjusted and output displayed through an IBM 2250 graphic display device. All capabilities available in the batch mode are available in the interactive mode. The interactive mode gives the user the additional capability to examine and modify data during program execution.

Historically, the GTDS batch mode has been used by analysts, while operations personnel have used both the batch and the interactive modes. With the advent of TCOPS, a modified form of the GTDS batch mode has been introduced, providing users in an IBM time sharing option (TSO) environment some

of the flexibility formerly available only in the interactive mode. This method of using GTDS relies on the User Interface Manager (UIM) program of TCOPS. In addition, a capability for GTDS to access tracking data currently being collected by TCOPS exists.

1.2 OVERVIEW OF GTDS DOCUMENTATION

GTDS is documented in several parts to satisfy the specific requirements of different audiences. The GTDS Design Manual (Reference 1) presents a comprehensive overview of GTDS capabilities for the programmer who is totally unfamiliar with GTDS. The manual emphasizes the structure of the software system and the relationships among the individual components of the system and, hence, is most suitable as an introduction to GTDS for programmers who must maintain and enhance the system. The manual is also helpful to the analyst who must be familiar with the system at the design level.

The Mathematical Theory of the GTDS (Reference 2) presents mathematical models and algorithms used in GTDS and is specifically directed to the analyst.

This document is directed to a general audience including operations personnel, analysts, programmers, and data technicians. Although a brief description of the system is provided, the principal contents are descriptions of the specific requirements for card image input to the system. There are two supplements to this guide. The GTDS Graphics User's Guide (Reference 3) describes the considerations specifically applicable to users in the interactive environment. The use of GTDS as a component of TCOPS is addressed in the TCOPS User's Guide (Reference 4).

This document also provides a user's manual for the UIM program, which aids the user in a TSO environment in setting up and executing GTDS jobs.

Details on GTDS components are available for programming and maintenance personnel in GTDS Module Descriptions (Reference 5), which provides a detailed description of subroutines in GTDS. Specifications for maintenance operations on the GTDS online data base files and individual file formats are collected in Testing, Reporting, and Maintenance Program (TRAMP) User's Guide (Reference 6).

1.3 OVERVIEW OF USER'S GUIDE

The purpose of this guide is to define all card input needed to run all GTDS programs in the normal (batch) mode. This input consists of data card decks needed by the GTDS programs, as well as any required job control language (JCL) cards. Execution of GTDS in the interactive mode would require all input presented in this guide, but numerous other considerations must be made in that mode of execution (see Reference 3).

This document presents the input data formats, units, and brief descriptions of the use of the data in GTDS. Mathematical algorithms are presented only when necessary to define an input quantity.

Because each program is executed individually, this document is organized so that the input data for each individual program are collected in one place. For each program, there is required input as well as numerous optional input items. The required data are presented first. With only these required data, the user can obtain a basic program execution but the optional features will not be used. Data causing execution of optional features to that program are then introduced, and detailed information on how to invoke these options is presented.

Section 2 of this document provides a general description of the card input requirements, emphasizing card input rules that apply to all programs. Users unfamiliar with GTDS should study Section 2 carefully before proceeding to other sections. Section 3 defines the specific input card requirements for each program, starting with an explanation of the most simple configuration and expanding to an explanation of the use of all applicable options. Section 4 gives the specific details on the format and contents of each card. Section 5 contains the JCL requirements for GTDS execution. The appendixes provide general quick-reference information for users already familiar with GTDS input requirements. Descriptions of GTDS printed output also appear in the appendixes.

SECTION 2 - GENERAL DESCRIPTION OF INPUT REQUIREMENTS

This section addresses the required program input cards that must be used to obtain a GTDS program execution. The required program inputs are dependent on the GTDS program being used. This section, therefore, defines the general input requirements and describes in detail only those input cards required by every GTDS program.

The simplest way to exercise GTDS is through the execution of a single GTDS program. A program input deck, which consists of a series of keyword cards, is used to invoke the execution of a specific program. Each keyword card contains an alphanumeric identifier consisting of from one to eight characters (left-adjusted) in the first eight columns of the card; this field is followed by fields of integer and real data. The alphanumeric identifier on the keyword card is referred to as the keyword.

This keyword-oriented input was established in GTDS for several reasons. Each keyword name is an acronym for, or the name of, some easily recognizable program option or data quantity. Also, several data values associated with that data quantity or option can be included on the same card. The user can, therefore, remember how to specify program options. In addition, this design allows for a deck that is relatively independent of card order, thereby eliminating many potential user errors possible in a card-order-dependent deck setup.

One of the few rules governing input card order, however, is that each input deck must begin with a CONTROL keyword card and end with a FIN keyword card. The CONTROL keyword card contains a field specifying the GTDS program to be executed, and the FIN keyword card indicates the end of the input deck.

The other cards in the deck depend on the particular program to be executed, as indicated on the CONTROL keyword card. Each program requires a particular number of mandatory keyword cards (from zero to five, depending on the program) that must follow the CONTROL card. In GTDS, a mandatory keyword always has this specific meaning. These mandatory keyword cards can be in any order, but all cards defined as mandatory for a given program must be included or an error message will be printed and program execution will be terminated.

Following the mandatory cards, one or more subdecks can be included. A subdeck consists of a group of functionally related keyword cards that specify and invoke program options. The subdeck is usually optional and begins with a subdeck identifier keyword card and ends with an END keyword card. All keyword cards between the subdeck identifier keyword and the END keyword card must be valid keyword card names for that particular subdeck. Any subdecks used must follow all mandatory keyword cards included in the program input deck. The order of subdecks is restricted, however. If the TDROPT deck is used it must be the first subdeck in a deck. If a TDROPT subdeck is not used, then the DMOPT deck must be the first subdeck. The DMOPT subdeck will be the second subdeck whenever the TDROPT subdeck is used. (See Section 4 for a description of TDROPT and DMOPT.)

The relationship between the CONTROL keyword card, mandatory keyword cards, subdecks, and the FIN keyword card within the program input deck is illustrated by the sample shown in Figure 2-1. As the figure shows, the input deck specifies the execution of Program 1, which uses three mandatory keyword cards and two subdecks.

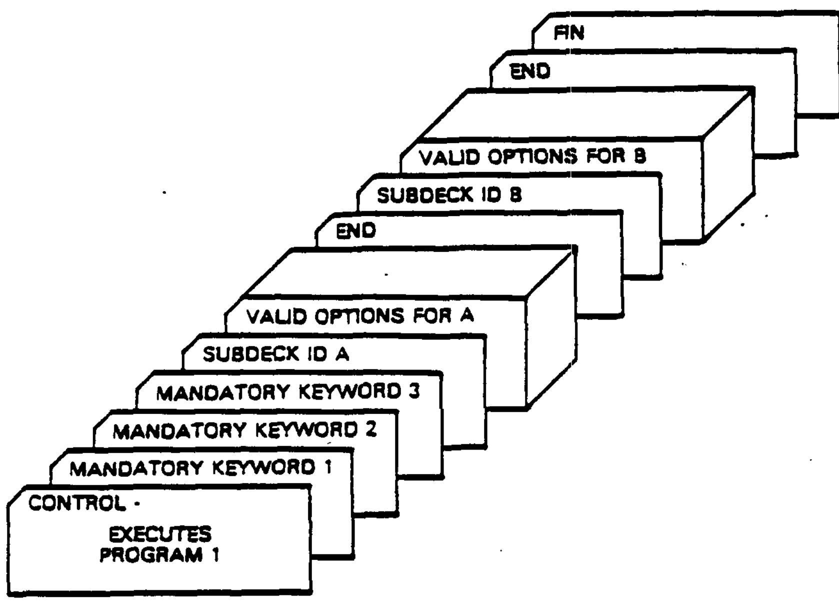

Figure 2-1. Sample Input Deck

To provide flexibility to the user, several card input decks can be included in the input stream to perform sequential execution of GTDS programs or to stack run cases. For example, the user may create an input deck for Program 1 and an input deck for Program 2 and then execute the programs sequentially simply by placing the input deck for Program 2 behind the input deck for Program 1.

The preceding paragraphs have given a general description of the input needed for a GTDS run. If any of the instructions are violated, a GTDS error message will be printed and program execution will be terminated. The remainder of Section 2 describes in detail the information required on the keyword cards for any GTDS program execution. Section 2.1 describes information on the CONTROL and FIN cards. Because the mandatory keyword card requirements and subdeck requirements vary according to the program being executed, only general descriptions are presented in Sections 2.2 and 2.3. Specific descriptions of mandatory keyword cards and subdecks are given in Section 3.

2.1 CONTROL AND FIN KEYWORD CARDS

The CONTROL and FIN keyword cards, respectively, begin and end every program input deck. The CONTROL keyword card initiates execution of a specific program. The CONTROL card also controls printing of the input card images and provides a means for identifying the satellite by name and number. Only one GTDS program can be initiated with each CONTROL card. A run consisting of the execution of multiple GTDS programs can be executed by stacking program input decks in sequence, each beginning with a CONTROL card and ending with a FIN card. The format of the CONTROL card is (6(A8, 2X), A8, I2, 1X, I7). The fields are defined in Table 2-1.

Table 2-1. Detailed Description of the CONTROL Card (1 of 2)

Column	Field Name	Description
1-8	CONTROL	CONTROL must be punched in columns 1-7; this initiates the GTDS program execution.
9-10		Blank
11-18	Program identifier	Identifies the name of the program to be executed. The name must be one of the following: EPHEM DATASIM DATAMGT DC ANALYSIS FILERPT EARLYORB COMPARE The program identifier must be left-justified (there is no default).
19-20		Blank
21-28	Indicator for inter active real-time mode	Indicates real-time observation handling when operating in the interactive mode: = blank (default), nonreal-time = REALTIME, real-time The real-time mode is discussed in detail in the GTDS Graphics User's Guide (Reference 3).
29-30		Blank
31-38	Indicator for printing card images	Indicates whether or not input card images are to be printed: = blank (default), print all card images = NO-PRINT, print only erroneous card images
39-40		Blank
41-48	Element source indicator	Indicates if elements and epoch are to be passed through a COMMON block from a previous program execution: = blank (default), not passed = INPUT, pass initial values from preceding program execution = OUTPUT, pass final values from preceding program execution = TDROUTDC, pass final TDRS elements from preceding TDRSS DC program execution

Table 2-1. Detailed Description of the CONTROL Card (2 of 2)

Column	Field Name	Description
		The element source indicator must be left-justified.
49-50		Blank
51-58	COMMON value restore option	Indicates whether or not COMMON block values are to be restored to default a priori: = blank (default), do not restore = nonblank (any character), restore
59-60		Blank
61-68	Satellite name	Specifies user satellite alphanumeric name
69-70	Error control indicator	Controls OS/VS2 IHO type error printout: = blank or zero (default), default to OS/VS2 control = -1, do not print any IHO error messages and do not terminate run for IHO error types 210 through 300 = nn (nn 0), print any IHO error message nn times and do not terminate run
71		Blank
72-78	Satellite number	Indicates number by which a satellite is identified; usually a 7-digit international designator. If fewer than 7 digits are used, right-justify the number. This will be the user satellite number when the TDRSS processing capability is invoked.
79-80		Blank

Certain information is required on every CONTROL card. The keyword field (card columns 1 through 8) must contain the word CONTROL starting in card column 1. The program identifier (card columns 11 through 18) must be one of the names listed in Table 2-1 and must start in column 11. The satellite number is required in columns 72 through 78. A unique satellite number is assigned at the time of the satellite launch, and all observation data use this number as an identifier. The satellite number used in DC Program input decks must be correct as it will be compared with the satellite number on the observation source. The number is a requirement for all other program decks but is only used for printer reports. The satellite number on the CONTROL card must be the user (target) satellite number for runs that process Tracking and Data Relay Satellite System (TDRSS) tracking data. (See Section 3.2.2 for further information on the use of TDRSS processing capabilities.)

The remaining fields on the CONTROL card revert to default values if they are not supplied by the user. These default values are defined in the description columns of Table 2-1.

Two fields on the CONTROL card, namely, the COMMON value restore option field (columns 51 through 58) and the element source field (columns 41 through 48), only apply when multiple decks are used. These fields should be used cautiously even by those who are familiar with using GTDS. Following execution of the program specified in any deck, the GTDS default a priori COMMON block values are not generally restored. In the execution of a second program, the user may wish to use the values that resulted from the first program execution, or he may wish to restore the values to their system defaults. This is controlled via the COMMON value restore field of the CONTROL card. An even more specific

requirement, to use the elements and epoch from the previous program's execution, may also be satisfied by supplying the appropriate data in the element source field of the CONTROL card. The user should note, however, that restoring the COMMON block values also restores the element storage locations, making the two options mutually exclusive.

The FIN keyword, as previously mentioned, is required as the last card of each program input deck. The keyword is specified by the characters FIN in the first three columns of the card.

2.2 MANDATORY KEYWORDS

A specific set of mandatory keyword cards must be supplied in each program input deck. These cards generally represent the minimum amount of data that are required to execute that program. The mandatory keyword cards must be physically located after the CONTROL card and can be in any order, but they must precede all subdeck keyword cards. All mandatory cards required by a specific program must be supplied to avoid abnormal termination of the program execution. The mandatory keywords associated with each program are shown in Appendix E. Specific mandatory keyword requirements for each program are presented in the detailed input description for each program in Section 3.

2.3 SUBDECKS

A subdeck is a collection of functionally related program options. Every subdeck must begin with a subdeck identifier keyword card and must end with an END keyword card. Subdecks are usually not required to obtain an execution of a GTDS program, but they are needed to invoke specific options that the user may desire. If used, the subdecks must follow

the mandatory cards in the deck. The valid subdeck identifier keyword names and the associated functions of each subdeck are as follows.

- OGOPT--Specifies program options related to orbit generator functions
- DCOPT--Specifies options common to the DC process
- COMPOPT--Specifies options for the ephemeris comparison process
- DMOPT--Specifies options related to file operations and data management
- PFROPT--Specifies options for generating permanent file reports
- TDROPT--Specifies options for the TDRSS data processing capability

Only specific subdecks are applicable to each program. The valid subdecks for each program are given in Appendix E. For some programs, a subdeck is required for any execution and therefore is not optional. These cases are also noted in Appendix E.

Any subdeck that is valid for a particular program can be included in the input deck following the mandatory keyword cards. Subdecks can be supplied in any order within a program input deck, except that if the TDRSS processing subdeck (TDROPT) and the data management option subdeck (DMOPT) are used, the TDROPT subdeck must precede all other subdecks; otherwise, the DMOPT subdeck must precede all other subdecks. The DMOPT subdeck must be the second subdeck if the TDROPT subdeck is used.

2.4 INSTRUCTIONS FOR FURTHER USE OF THE GUIDE

Keeping in mind this general organization of the input deck, the user may now consult the individual program input descriptions in Section 3 to determine which mandatory keywords and subdecks should be included for a particular run. These descriptions provide a list of capabilities and options available with details on how they are to be used in the programs. Once the user has determined which keywords are to be used, he or she should consult Section 4, which provides details on the information required on each keyword card and the input format to be used.

For quick reference, the user should also consult the following appendixes:

- Appendix E--Required and Optional Program Input (mandatory keyword cards for each program, and required and acceptable subdecks for each program)
- Appendix F--GTDS Keywords Functional Description and Cross-Reference (alphabetical listing of keywords and cross-referenced alphabetical listing by function)

SECTION 3 - PROGRAM INPUT DESCRIPTION

Section 3 describes the input for each program in GTDS. For each of the programs, a separate section, preceded by its own table of contents, describes that individual program. Every section contains a summary of the program function and the type of input data needed to satisfy that function. Following the summary, the required input keywords are specified, and all optional subdecks with input keyword cards that apply are listed. Specific details on how to use keyword cards that apply to the program are also given. Section 4 describes in detail the actual keyword formats, and Appendix G shows sample program input decks.

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3.1 EPHEMERIS GENERATION (EPHEM) PROGRAM

The primary function of the EPHEM Program is to compute a time history of a spacecraft trajectory from a given set of initial conditions. Typical output is in the form of a printer file of Cartesian coordinates and Keplerian and spherical orbital elements at various times during the trajectory. One can optionally output disk or tape satellite ephemeris files for use in the Differential Correction (DC), Data Simulation (DATASIM), Error Analysis (ANALYSIS), and COMPARE Programs. In addition, the EPHEM Program can be used to advance elements from the given epoch to another and to store the new elements in a file or COMMON block for use in subsequent runs.

The input data specified for an EPHEM Program run are classified as follows:

- Initial elements and epoch (Section 3.1.3)
- Orbit generation selection (Section 3.1.4)
- Conversion of osculating-to-mean elements (Section 3.1.5)
- Selection of numerical integration method (Section 3.1.6)
- Output file creation (Section 3.1.7)
- Output file retrieval (Section 3.1.8)
- Force model options and keywords (Section 3.1.9)
- Partial derivatives (Section 3.1.10)
- SLP Ephemeris File (Section 3.1.11)

Mandatory keyword cards in the EPHEM Program specify initial conditions, orbit generator type and key options, principal integration parameters, and output parameters. If no other input is supplied, the EPHEM Program will operate with

default values for force model and optional integration parameters. The default values and the procedure for modification are discussed in Section 4, Keyword Card Descriptions. The subdecks applicable to the EPHEM Program are DMOPT and OGOPT.

Sections 3.1.1 and 3.1.2 list all the permissible keywords, both required and optional, that can be used in an EPHEM Program input deck, and the remaining subsections of Section 3.1 describe their use.

3.1.1 EPHEMERIS GENERATION REQUIRED KEYWORDS

All keywords required for an EPHEM Program run are listed below, with their functions.

- CONTROL--Initiates EPHEM Program run
- ELEMENT1*--Sets coordinate system, reference central body, and first three components of the state
- ELEMENT2*--Sets second three components of the state
- EPOCH*--Specifies epoch of the state
- ORBTYPE--Sets orbit generator type and principal integration parameters
- OUTPUT--Sets end time and print interval of program execution
- FIN--Indicates end of the program deck for the EPHEM Program

The first card in the EPHEM deck must be the CONTROL keyword that is used to initiate the program. The mandatory keywords ELEMENT1, ELEMENT2, EPOCH, ORBTYPE, and OUTPUT must follow the CONTROL keyword card. If any data management

*These keyword cards may be omitted if epoch and elements are obtained from sources other than card input (see Section 3.1.3).

functions are required, these mandatory keywords must be followed by the DMOPT subdeck keyword, optional data management keywords, and the keyword END (see Section 3.1.2.1). If orbit generation options are required, the subdeck keyword OGOPT with the proper optional keywords and an END keyword card may then be included (see Section 3.1.2.2). The final card in the EPHEM Program input deck must be the FIN keyword card that indicates the end of the program input deck.

This program input deck can be followed by another program input deck or decks that cause sequential runs of EPHEM, DC, or any of the other GTDS programs.

3.1.2 EPHEMERIS GENERATION OPTIONAL KEYWORDS

Section 3.1.2 lists all the optional keywords that may be included in an EPHEM Program run.

3.1.2.1 Optional Data Management Keywords (DMOPT Subdeck)

The optional keyword cards in the DMOPT subdeck, with their principal functions, are as follows:

- DMOPT--Identifies the subdeck type as the Data Management Subdeck
- Lifetime study mode (see Section 3.1.14)
  - LIFETIME--Sets the ephemeris generation for the lifetime study mode and sets an indicator to retrieve elements
- Retrieval of data base force model, integration, and elements data (see Section 3.8.5)
  - WORKATM--Builds Atmospheric Density Working File
  - WORKCON--Builds Astrodynamic Constants Working File

- WORKELS--Builds Elements Working File
- WORKMAN--Builds Impulsive Maneuvers Working File
- WORKINT--Builds Integration Coefficients Working File
- WORKSECT--Builds Flight Sectioning Working File
- WORKTCOR--Builds Time Conversion Coefficients Working File

- Creation of permanent or temporary SLP Ephemeris Files (see Section 3.8.4)
  - SLPBODY--Selects the central and noncentral bodies for generating the SLP Ephemeris File
  - SLPCOORD--Specifies the SLP ephemeris coordinate system reference
  - SLPDEG--Sets the degree of curve fit for SLP bodies
  - SLPFILE--Indicates source of data to be used in creating the SLP working file. If a Jet Propulsion Laboratory (JPL) tape input is desired, this option can only use the DE-19 format input SLP tape supplied by JPL (see References 7 and 8). DE-96 tapes must be processed by TRAMP (see References 6, 9, and 10).

3.1.2.2 Optional Orbit Generator Keywords (OGOPT Subdeck)

The optional keyword cards in the OGOPT subdeck are as follows:

- OGOPT--Identifies the subdeck type as the Orbit Generation Subdeck

- Change force model constants from default values
  - ATMOSDEN--Defines format of the atmospheric density table and specifies drag model as either Harris-Priester or Jacchia-Roberts [Definitive Orbit Determination System (DODS) or GTDS format]
  - ATTANG1--Sets satellite spin axis right ascension or yaw angle polynomial coefficients
  - ATTANG2--Sets satellite spin axis declination angle or pitch angle polynomial coefficients
  - ATTANG3--Sets satellite spin axis roll angle polynomial coefficients
  - BDROTATE--Sets rotation rates of the planetary bodies
  - BODYRAD--Sets equatorial radii of the planetary bodies
  - CNM--Sets geopotential or lunar potential harmonic coefficients, $C_{n,m}$, options and values
  - COVARNC--Sets upper triangle of the a priori state covariance matrix
  - DRAGCOF--Sets polynomial coefficients of ρ_1 by flight section
  - DRAGPAR--Updates aerodynamic drag parameters and sets the drag partial derivatives switch
  - DRAGPOLY--Sets the number of polynomial coefficients of ρ_1 to be solved for by flight section (see keyword DRAGCOF in Section 4)

- FLATCOEF--Sets the inverse of the flattening coefficients of the planetary bodies
- GMCON--Sets gravitational constants for the planetary bodies
- HARMONIC--Reads the geopotential or lunar potential table
- IMPULSE--Sets impulsive maneuver velocity increments
- MANMASS--Sets satellite mass required to compute an impulsive maneuver
- MANTIME--Specifies the time of the impulsive maneuver
- NPQPAR--Sets Brouwer drag coefficients, $N_{p,q}$ values and solve-for switches
- POTFIELD--Retrieves geopotential harmonic coefficients
- RAPRIME--Sets the right ascension of the prime meridian of specified planetary bodies
- RATIME--Sets the time associated with the right ascension on the RAPRIME keyword card
- SCPARAM--Sets spacecraft area, mass, and radius
- SCPARAM2--Sets cylindrical spacecraft parameters and paddle configuration
- SNM--Sets geopotential or lunar potential harmonic coefficients, $S_{n,m}$, options and values
- SOLRDPAR--Updates solar radiation parameter, C_R, and sets the solar radiation partial derivatives switch

- SPHERE--Sets sphere of influence for the planetary bodies
- TITLE--Allows input of various titles
- THRSTCOF--Sets thrust magnitude coefficient data
- THRSTVAR--Sets variance of thrust accelerations, vehicle right ascension and declination

• Change force model options (numerical and semi-analytic type theories only)

- APOFOCAL--Defines the sectioning parameter to cross at apofocal distance
- AUTOFORC--Sets the option for automatic force model selection (inclusion of resonance potential)
- AVERAGE--Sets the variation of parameters numerical averaging option
- CBODY--Sets central body indicators by flight section
- DISTCB--Sets distance from the current central body at which sectioning is to occur
- DISTNCB--Sets distance from the next central body at which sectioning is to occur
- DRAG--Sets force model drag option for each flight section
- IMPACT--Enables modeling of atmospheric density at low altitudes; also listed as numerical integration option

- MAXDEGEQ, MAXORDEQ — Set maximum degree and order, respectively, for evaluating the nonspherical potential of the central body for the equations of motion

- MAXDEGVE, MAXORDVE — Set maximum degree and order, respectively, for evaluating the nonspherical potential of the central body for the variational equations

- MAXSECT--Sets number of flight sections

- NCBODY--Sets noncentral bodies for each section

- POLAR--Sets polar motion option for each section

- RCACB--Defines sectioning parameter radius of closest approach for the central body

- RCANCB--Defines sectioning parameter radius of closest approach for the next central body

- SOLRAD--Sets force model solar radiation option for each section

- SPHINF--Sets indicators for ending the current section if the sphere of influence changes

- THRUST--Sets the finite thrust option for each section

- TOF--Sets time of flight at which sectioning is to occur

- TWOBODY--Sets two-body option in the force model for specified section

- Change options for the computation of partial derivatives
  - ATTPAR--Sets the number of right ascension and/or declination partial derivatives to be computed
  - CNM
  - SNM

    Set the options to compute position and velocity partial derivatives with respect to $C_{n,m}$ and $S_{n,m}$
  - DRAGPAR--Sets the option to compute position and velocity partial derivatives with respect to the aerodynamic drag model parameters
  - SOLRDPAR--Sets the option to compute position and velocity partial derivatives with respect to solar radiation model parameters
  - STATEPAR
  - STATETAB

    Set the options to compute position and velocity partial derivatives with respect to initial state parameters
  - THRSTPAR--Sets the options to compute position and velocity partial derivatives with respect to thrust magnitude parameters
- Change numerical integration options and tolerances
  - IMPACT--Enables automatic switch to Hull Runge-Kutta integrator below specified height; also listed as force model option
  - INTEG--Sets numerical integration parameters, type and order
  - INTMODE--Sets section-dependent stepsize control switch

- LOWBOUND, NOMBOUND, UPPBOUND: Set lower, nominal, and upper truncation-error tolerances, respectively, for stepsize control
- MEANEL--Sets osculating-to-mean elements conversion option for the averaging orbit integrators
- RESTART--Sets numerical integration starter method
- SHELLRAD--Sets radial distances and stepsize for integration when using the shell mode
- STEPSIZE--Sets integration stepsize by flight section
- TIMREG--Sets the section-dependent time-regularization parameter for the time-regularized Cowell orbit theory
- TIMREGDV--Sets section-dependent, time-regularized stepsize parameter
- TOLER--Sets various integration tolerances

- Change orbit generator output options
  - EPHQLCRT--Requests printout of selected vectors from EPHEM or ORB1 Files
  - HISTPLOT--Sets element history plot options
  - HSTSCALE--Sets scales for element history plots
  - INTEROUT--Sets intermediate output options for the orbit generator
  - OUTBODY--Sets additional section-dependent output reference bodies
  - OUTCOORD--Sets the section-dependent coordinate system orientation for output

- OUTOPT--Sets output options for ephemeris files
- OUTPART--Sets output options for state partial derivatives
- OUTTYPE--Sets output options for orbital element types
- TIMES--Sets reference date and start of print time
- VAREPHEM--Sets the time intervals between data points of variable-step EPHEM Files by satellite height

3.1.3 INITIAL ELEMENTS AND EPOCH

The following four methods are provided for inputting initial elements and epoch into an EPHEM Program run:

- Punched-card input
- 24-Hour Hold Elements File
- GTDS Permanent Elements File
- COMMON block from a previous step within the same job
- Permanent TDRS Orbit File (PTOF)

These methods are described in the following sections.

3.1.3.1 Input Elements via Card Input

The keywords ELEMENT1, ELEMENT2, and EPOCH allow punched card input of initial elements. (For full descriptions of these keyword cards, see Section 4.)

3.1.3.2 Input Elements via GTDS Files

Elements from a DC Program run can be stored in one of the two GTDS elements files, the 24-Hour Hold Elements File or

the GTDS Permanent Elements File. These elements can subsequently be used as input to an EPHEM Program run. In this case, a user must supply, in a DMOPT subdeck, the WORKELS keyword that contains the type of file and element set number. (For further description of this information, see WORKELS in Section 4.) When elements are supplied through the WORKELS keyword, the ELEMENT1 and ELEMENT2 keyword cards are not required.

3.1.3.3 Input Elements via COMMON Block

Initial elements and epoch can be passed through COMMON from a previous GTDS program execution within the same job step (e.g., a DC Program execution). The use of this option is explained in the description of the CONTROL keyword in Section 2. When the elements are supplied through COMMON, the ELEMENT1, ELEMENT2, and EPOCH keyword cards are not required.

3.1.3.4 Input Elements via PTOF

Input elements may be retrieved from a PTOF. In this case, a user must supply a WORKELS keyword card in the DMOPT subdeck. The FORTRAN reference number (FRN) of the PTOF must be specified and must be 71, 72, or 73. Either the PTOF level number of the time at which to extract the elements (or both) also must be supplied. A level number of -1 may be specified if the time is specified. In this case, the level with the latest possible start time is accessed. If the time is not specified and only the level number is supplied, the epoch vector from that level is used. (For further description of this information, see WORKELS in Section 4). When elements are retrieved from a PTOF, the ELEMENT1, ELEMENT2, and EPOCH keyword cards are not required.

3.1.4 ORBIT GENERATION SELECTION

The orbit generation type is specified via the ORBTYPE keyword card. The time-regularized Cowell, Cowell, variation of parameters (VOP) (types 1 through 10), Hull Runge-Kutta (type 13) and Chebyshev-series orbit generators are all high-precision, numerical integration methods. The Brouwer, Brouwer-Lyddane, and Vinti orbit generators are analytic methods. The VOP methods (types 11 through 20, excluding type 13) are averaged numerical integration methods. The Cowell time-regularization constants can be modified by means of the TIMREG keyword card. Options for the numerically averaged orbit generators can be specified by the AVERAGE and MEANEL keyword cards. Certain data values used by the orbit generator may be modified by data base retrieval (see Section 3.2.1.20).

3.1.5 CONVERSION OF OSCULATING-TO-MEAN ELEMENTS

If a numerically averaged orbit generator has been requested via the ORBTYPE keyword card and osculating elements have been input, a numerical osculating-to-mean element conversion is performed. This conversion requires the generation of an ORBIT File. The default method for the osculating-to-mean element conversion is to create the ORBIT File using the time-regularized Cowell orbit with a stepsize of 150 steps per revolution and then to average osculating elements over one satellite revolution. The orbit generator, stepsize, and number of revolutions to be averaged over can be modified using the MEANEL keyword card.

3.1.6 SELECTION OF NUMERICAL INTEGRATION METHOD

The default numerical integration method in GTDS is a twelfth-order Cowell multistep integrator. The fixed stepsize mode is the default. However, three variable stepsize

options are available: halving-doubling, regular vary-step, and the variable stepsize shell mode. Reference 2 provides information to assist in selecting integration options. These options are specified on the ORBTYPE keyword card. For fixed-step integration, the stepsize is also input on the ORBTYPE keyword card. For variable stepsize integration, the default initial stepsize of 24 seconds can be modified by input on the ORBTYPE keyword card. For multisection flights, this information is specified on the INTMODE, TIMREGDV, or STEPSIZE keyword card.

The variable step size tolerances can be modified using the TOLER keyword card. For example, to change the lower truncation error bound, which is used to control stepsize increases, the following card is required in the OGOPT subdeck:

Columns 1 - 8	11	18 - 38
TOLER	2	0.1D-12

For multisectioned trajectories, this information is specified on the LOWBOUND, NOMBOUND, and UPBOUND keyword cards.

A single-step Runge-Kutta integration method is also available in GTDS in conjunction with the Cowell orbit theory and can be specified via the INTEG and ORBTYPE keyword cards. For example, to specify the Runge-Kutta integrator, the following cards are required:

```
Columns 1 - 8   11

        ORBTYPE 1
        .
        .
        .
        OGOPT

        INTEG 4
```

Both multistep and single-step starting procedures are available for the multistep integrator. The multistep default can be modified using the RESTART keyword. The order of the multistep numerical integration method can be modified by supplying the WORKINT keyword card in a DMOPT subdeck.

In addition to the Runge-Kutta integrator available through the Cowell theory generator, there is a Runge-Kutta integrator with Hull coefficients available as option 13 in the first field of the ORBTYPE keyword card. When used in vary-step mode (integration step mode = 2), the integrator will automatically change integration stepsize to an optimal value based on predicted truncation error. See Reference 11 for a description of the algorithm. While this integrator is useful in situations in which the force model is highly variable, it has a high processing cost due to repeated calls to the force model at every step.

The starter stepsize control parameters, which are used in the variable stepsize shell mode method, may be altered using the SHELLRAD keyword card.

3.1.7 OUTPUT FILE GENERATION

Four kinds of satellite ephemeris files are generated by the EPHEM Program: EPHEM Files, ORB1 Files, Ephemeris Data File Preparation (EDFP) Files, and ORBIT Files. In any EPHEM Program run, up to two satellite ephemeris files can be requested using the OUTOPT keyword card.

3.1.7.1 EPHEM Files

EPHEM Files are the principal means by which satellite ephemeris information is transmitted to users not performing orbit determination, such as users involved with tracking data acquisition or maneuver planning. The two types of

EPHEM Files are Fixed-Step EPHEM Files and Variable-Step EPHEM Files. Both types consist of data records preceded by two header records and followed by an end sentinel record.

3.1.7.1.1 Fixed-Step EPHEM Files

Fixed-Step EPHEM Files contain the position and velocity of a satellite at points in time separated by a fixed, user-specified interval. This output interval can be specified via the OUTOPT keyword card.

3.1.7.1.2 Variable-Step EPHEM Files

Variable-Step EPHEM Files differ from Fixed-Step EPHEM Files only in that the time interval between the ephemeris points on the file is a function of satellite height above the Earth. The time interval is constant between the points of each data record, but different data records may have different intervals. The specification of the minimum satellite heights corresponding to user-specified time intervals is accomplished using up to five VAREPHEM cards in the OGOPT subdeck. The time interval corresponding to the lowest satellite heights (i.e., those between the Earth's surface and the lowest minimum satellite height on the VAREPHEM cards) is specified via the OUTOPT keyword card.

3.1.7.2 ORB1 Files

ORB1 Files are satellite ephemeris files that can be used as input to the DC Program for the Precision Conversion of Elements (PCE). Like Fixed-Step EPHEM Files, ORB1 data records contain 50 points separated by a time interval specified by the OUTOPT keyword card. ORB1 Files consist of such data records preceded by a header record and followed by two consecutive end sentinel records.

3.1.7.3 EDFP Files

EDFP Files are used to transmit satellite ephemeris information in a PDP-11 compatible format. EDFP data records contain Chebyshev coefficients for representing satellite position and velocity as polynomials in time (from the start time of the record). Unlike the other GTDS ephemeris files, EDFP Files represent the satellite ephemeris only in a body-fixed true-of-date (TOD) coordinate system. EDFP Files contain only a single header record followed by data records. EDFP Files can only be generated when the Chebyshev orbit generator has been requested on the ORBTYPE keyword card.

3.1.7.4 ORBIT Files

The capability to generate an ORBIT File is available only for the Cowell and time-regularized Cowell orbit generators, since the information stored in the ORBIT File is unique to the Cowell orbit generators. The ORBIT File can be created either with or without partial derivatives and can be written as either a direct access [IBM FORTRAN direct access or GSFC direct-access input/output (DAIO) format] or a sequential file. (See Section 5 for a description of the JCL requirements.)

3.1.8 OUTPUT FILE RETRIEVAL

The EPHEM Program can be used to retrieve and print the satellite state and partial derivatives from an ORBIT File. This option is specified on the ORBTYPE keyword card.

3.1.9 FORCE MODEL OPTIONS AND KEYWORDS

The default force model for GTDS includes one section with the Earth as the central body and the Sun, Moon, and a 4-by-4 gravity field as the perturbing forces. The definition of the force model and various force model parameters can be

modified in the OGOPT subdeck. These force model parameters may be modified for each section of a multisection EPHEM Program run.

The keywords that pertain to various force models are as follows.

- RAPRIME, RATIME, POLAR, BDROTATE, BODYRAD, FLATCOEF--Physical constants of planetary bodies
- GMCON, NCBODY, SPHERE, CBODY--Point mass gravitational force
- MAXORDEQ, MAXDEGEQ, HARMONIC, SPHERE, CBODY, CNM, SNM, AUTOFORC--Nonspherical gravitational force
- NPQPAR, DRAG, DRAGPAR, DRAGPOLY, DRAGCOF, ATMOSDEN, SCPARAM, SCPARAM2, ATTANG1, ATTANG2, ATTANG3, IMPACT--Atmospheric drag
- SOLRAD, SOLRDPAR, SCPARAM, ATTANG1, ATTANG2, ATTANG3--Solar radiation pressure
- THRUST, THRSTVAR, THRSTCOF, ATTANG1, ATTANG2--Thrust
- IMPULSE, MANMASS, MANTIME--Impulsive maneuvers

3.1.10 PARTIAL DERIVATIVES

In an EPHEM Program run, the partial derivatives of the state with respect to any of the dynamic solve-for or consider parameters can be computed and output as part of the printer report or an ORBIT File. These partial derivatives are computed by numerically integrating the variational equations (see MAXDEGVE and MAXORDVE keyword cards). A priori values may be supplied through keyword card input. This option is available only for the Cowell, time-regularized Cowell, and VOP orbit generators. (Reference 2, Chapter 5, presents a detailed discussion of these orbit generators.) Alternatively, partial derivatives with respect to the initial state can be approximated by analytical

two-body partial derivatives. This option is available for all orbit generators (TWOBODY keyword card).

Computation of these partial derivatives is specified using the STATEPAR keyword card and further defined using the ATTPAR, DRAGPAR, SOLRDPAR, STATETAB, THRSTPAR, CNM, SNM, and NPQPAR keyword cards. The option to print partial derivatives is invoked through the OUTPART keyword card.

A priori values for the state covariance matrix can be input using the COVARNC keyword card (see Section 3.2.1.10.1). If the matrix map option is selected via the STATEPAR card, the covariance matrix will be mapped to another epoch; that is, it will be mapped to the end time of integration.

3.1.11 SLP EPHEMERIS FILE

Planetary ephemeris data are available to the EPHEM Program through the SLP Ephemeris File. This file contains ephemerides of selected planetary bodies, transformations from selenocentric to selenographic coordinates, transformations between the true equator and equinox of date coordinate system and the mean equator and equinox of 1950.0 reference coordinate system, and the Greenwich hour angle (GHA). The data on the SLP File consist of coefficients of Chebyshev polynomials fit to data obtained from an ephemeris representation tape provided by the JPL.

GTDS has been provided with the optional capability to solve the equations of motion in either the mena equator and equinox of 1950.0 coordinate system or a true equator and equinox of "reference date" coordinate system, where the reference date is specified by the user. Thus, two SLP Files are available: the Mean of 1950.0 SLP File, which contains ephemeris information for the mean of 1950.0 coordinate system option, and the TOD SLP File, which contains

information for the TOD coordinate system option. Generally, GTDS program runs utilize the 1950.0 SLP File. Both 1950.0 and TOD SLP Files that cover the period from January 1974 to January 1986 are available to GTDS users. The appropriate SLP File is used, depending on the integration coordinate system specified on the ORBTYPE keyword card. These files include all eight planets, the Earth's Moon, and the Sun. Chebyshev polynomials of order 9 are used for planets and Sun positions, and of order 19 and 12 for the Moon's position and velocity, respectively.

There will be instances when the available SLP Files are inadequate for particular applications. For example, the user may wish different planetary bodies to be included in the file or may want different degree polynomials. GTDS has the capability of using JPL ephemeris tapes as input to create an SLP File consisting of Chebyshev coefficients (see Reference 12). GTDS can process as input a JPL ephemeris tape in the DE-19 or DE-96 tape format (see References 7, 8, 9, and 10); the DE-96 tape format is the default. The DE-19 and DE-96 formats are not compatible so the GTDS user must make certain that the correct input JPL tape is supplied. The JPL DE-96 ephemeris tape format is explained in References 9 and 10.

To create a new file, the user must supply, in a DMOPT subdeck, one or more of the following keyword cards: SLPBODY, SLPCOORD, SLPDEG, and SLPFILE. A JPL planetary tape (in the DE-19 or DE-96 format) also must be provided on unit 34. The output SLP File will be written to unit 18. Section 4 provides details on the use of the keyword cards, and Section 5 provides details on the JCL required. If an SLP File of more than 12 records is created, both the JCL and the DEFINE FILE statement (in subroutine SETDAF) for unit 18

must be modified through the use of the UCLEG procedure. (See Section 5.3 for use of the UCLEG procedure.)

A JPL DE-96 tape is converted to an SLP File for use in GTDS by use of TRAMP. The DE19 format tape cannot be processed by TRAMP, however. The method for creating SLP Files using TRAMP is described in the TRAMP User's Guide (Reference 6).

A report of the coefficients contained on the permanent 1950.0 and TOD SLP Files may be obtained via the FILERPT Program (see Section 3.9). A report of the elements computed for each body on the file from these coefficients may be obtained during an EPHEM Program run by using the SLPELRPT card described in Section 4.

3.1.12 FLIGHT SECTIONING

Sectioning is a method for dividing the mission into separate segments, wherein the integration within each segment operates in a coordinate frame referenced to a specific central planetary body, and wherein each segment employs independent force model and printer output options. The sectioning feature is available for all GTDS integrators, but it is restricted to flights for which the integration span is entirely forward in time (i.e., the start time of integration is equal to or later than the epoch time, and the end time is later than the epoch time). This option was originally intended for interplanetary flights.

An EPHEM Program run can have a maximum of 10 flight sections specified through user input on the MAXSECT keyword card. If the multiple section feature is not desired, the EPHEM Program reverts to a single section flight, wherein the central body, force model, and printer output options used are those in effect for section one. Flights that are backward in time can only have one flight section.

The particular quantities that can be varied from section to section include the force model, integration method and stepsizes, print frequency, output reference system, coordinate system orientation, reference body, and partial derivatives. The EPHEM Program will advance to the next section during the integration process when any one of a set of specified section end conditions is recognized. The valid section end conditions and their associated keywords are as follows:

- Specified time of flight (TOF) from epoch time
- Distance from central body (DISTCB)
- Apofocal point referenced to central body of current section (APOFOCAL)
- Distance from central body of the next section (DISTNCB)
- Radius of closest approach to central body of current section (RCACB)
- Radius of closest approach to central body of the next section (RCANCB)
- Change in sphere of influence from one body to another (SPHINF)

3.1.13 PRINTED REPORT OPTIONS

Printed output may be controlled by keyword cards. INTEROUT sets the option to output intermediate values from selected subroutines. OUTCOORD sets the section dependent system of orientation. OUTBODY controls the addition of section dependent output reference bodies. OUTTYPE controls the orbital element types. TIMES sets the start of print time. In addition, plotting options may be controlled, as specified in Section 3.1.16.

3.1.14 LIFETIME STUDY MODE

A long-range time history of a spacecraft orbit can be generated in an EPHEM Program by invoking the lifetime study mode via keyword card LIFETIME. This long-term history, which may involve a period of many months, is basically an extended version of the usual EPHEM Program with the Lifetime Study Report replacing the EPHEM Satellite Ephemeris Report and, as such, requires the mandatory EPHEM cards. Input vectors can be supplied from cards or from the GTDS Permanent Elements File; in the case of the latter, a sequence of cases can be automatically run, starting and ending with the element set numbers specified by the user, and ELEMENT1, ELEMENT2, EPOCH, and WORKELS cards are not needed. Details are given on the LIFETIME keyword card description in Section 4.

The Lifetime Study Report for both inputs consists of the apogee radius, perigee radius, inclination, eccentricity, and inclination of orbital plane to ecliptic plane at time intervals specified on the OUTPUT keyword card. These are printed until the desired end time is reached or until the orbit is no longer within the specified perifocal and apofocal radii indicated on the LIFETIME keyword card. The time intervals can be negative (i.e., integration can be backwards in time). If the input is from the GTDS Permanent Elements File, a Satellite Ephemeris Report at the end time will be printed, and a message indicating the end of lifetime study cases will appear on the last EPHEM Final Report.

For a long-range study, numerical integration methods may consume a large amount of central processing unit (CPU) time if care is not taken; this problem does not arise if an analytic orbit generator such as the Brouwer method is used.

3.1.15 EPHEMERIS FILE OUTPUT VECTOR QUALITY REPORT

The Ephemeris File Output Vector Quality Report contains header information from EPHEM or ORB1 Files. This is followed by selected position and velocity vectors from the chosen file. Up to six vectors may be selected, each specified by a number from 1 through 50 on the EPHQLCRT keyword card. Each of these vectors will be reported for every data record on the file, along with the record number and associated time. The last vector on the file will also be reported.

3.1.16 EPHEMERIS ELEMENTS HISTORY PLOTS

History plots are plots of the state elements over time. Cartesian, Keplerian, and/or spherical element plots may be generated. The type of plots, plot stepsize, and plot timespan are input on the HISTPLOT keyword card in the OGOPT subdeck. Since the plotted points are extracted from an EPHEM File (whose generation is mandatory), the requested plot stepsize must be an integer multiple of the EPHEM File stepsize. The requested plot timespan must also fall within the timespan of the EPHEM File. The printer output option on the mandatory OUTPUT keyword card should specify Cartesian, Keplerian, and/or spherical elements output.

The following keyword cards are used to generate history plots.

- OUTPUT--Specifies Cartesian, Keplerian, and/or spherical output
- OGOPT--Orbit Generation Subdeck identifier
- OUTOPT--Requests EPHEM File generation
- HISTPLOT--Requests history plots
- END--End of Orbit Generation Subdeck

3.1.17 IMPACT MODELING

Impact modeling provides the capability to model a satellite's trajectory when that trajectory passes close to or impacts the surface of the Earth. The IMPACT keyword card controls extensions to GTDS integrators and force models. Card effects on orbit generation are summarized in the following paragraphs.

- If there is no IMPACT card in the OGOPT subdeck, trajectory propagation terminates if the trajectory altitude passes below 70 kilometers. When the IMPACT card is submitted, the altitude at which impact is reported becomes user specified (default = 0).

- While the trajectory altitude is above the transition height specified on the IMPACT card, the integrator specified on the ORBTYPE card is used. If the impact modeling extensions project the altitude below the transition height at the next integration step, the Hull Runge-Kutta integrator will be used. If the altitude is then projected to go above transition height, the integrator again will be that specified on the ORBTYPE card.

- The impact card can be used to enable a density model for the atmosphere at low altitudes. The Harris-Priester and Jacchia-Roberts models are not valid below a 100-kilometer altitude. The low-atmosphere model is based on the U.S. Standard Atmosphere, 1976, and provides atmospheric density values from a 110- to 0-kilometer altitude.

Impact modeling is designed for use only when executing an EPHEM program. The impact-height (the altitude at which trajectory propagation stops and an impact is reported) must be no less than zero. The transition height must be no less than the impact height. Note that if the user wishes to use

the low-atmosphere model without the Hull Runge-Kutta integrator ever being called, the integrator switch will be effectively disabled by setting both transition height and impact height to zero.

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3.2 DC PROGRAM

The purpose of the DC Program is to estimate the values of a set of parameters, called solve-for variables, in a mathematical model of spacecraft motion. The parameters are estimated so as to minimize, in a Bayesian weighted least squares sense, the sum of the squares of the differences between computed and observed trajectory data, while constraining the parameters to satisfy their a priori initial estimates to specified limits of uncertainty. (For the detailed description of the estimation process, see Reference 2.) The trajectory data required by the DC Program must be supplied by the user in permanent GTDS observation input disk files, temporary observation input files (tapes or disk), or punched input cards.

The following are components of the DC process.

- Initial elements and epoch
- Observation sources
- Orbit generator type and associated parameters
- Modified DC (Marquardt algorithm)
- Solve-for parameters
- Consider parameters
- Covariance matrix
- Variational equations for state parameters
- Tracking stations and Earth ellipsoid models
- Observation weighting
- Observation data editing
- Dynamic mathematical editing

- Tracking data observation corrections
- Convergence criteria
- Static biases for tracking data or attitude sensor data
- Output reports
- Tracking data validation plot file generation
- Data base retrieval
- SLP Ephemeris File
- Saving elements and observations files
- ORBIT, ORB1, and EPHEM Files
- TDRSS processing capability
- Satellite-to-Satellite Tracking (SST) data processing capability
- Residuals computation using EPHEM File input

The DC Program mandatory keywords will provide information related to the first three components. If no other inputs are supplied, the DC Program will execute with default values using the Cowell orbit theory and Cartesian state vector components. If the user wants to modify any of the default values, input is required using the TDROPT, DMOPT, OGOPT, and/or DCOPT subdecks.

Sections 3.2.1.1 and 3.2.1.2 list all the permissible keywords (both required and optional) to be used in a DC Program run. The rest of Section 3.2.1 describes their use with respect to the componets of the DC process. The individual descriptions of all keyword cards presented in Section 4 provide additional necessary information.

3.2.1 SINGLE SATELLITE MODE

3.2.1.1 DC Required Keywords (Single Satellite Mode)

This section gives all keywords required for a single satellite DC Program run. They are as follows.

- CONTROL--Initiates the DC Program run
- ELEMENT1*--Sets coordinate system, reference central body, and first three components of state
- ELEMENT2*--Sets second three components of state
- EPOCH*--Specifies the epoch of the initial state
- OBSINPUT--Specifies observation input sources and acceptable times
- ORBTYPE--Sets orbit generator type and related parameters
- FIN--Indicates end of DC Program input

The first card in the DC Program input deck must be the CONTROL card used to initiate the DC Program. The mandatory keyword cards ELEMENT1, ELEMENT2, EPOCH, OBSINPUT, and ORBTYPE must follow the CONTROL card.

If any data management functions are required, and a TDROPT subdeck is not used, the mandatory keyword cards must be followed by the DMOPT subdeck keyword, optional data management keywords, and the delimiter keyword END (see Section 3.2.2.1). If required, the subdeck keywords DCOPT and OGOPT with the proper optional keywords and END delimiters may then follow. These latter two subdecks may be in any order. The final card must be the keyword FIN, which indicates the end of the deck.

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*These keyword cards may be omitted if epoch and elements are obtained from sources other than card input (see Section 3.2.1.3).

This program input deck can be followed by another program input deck or decks that cause sequential runs of the other GTDS programs.

3.2.1.2 DC Optional Keywords

Section 3.2.1.2 lists all the optional keywords that may be included in a DC Program run.

3.2.1.2.1 Optional Data Management Keywords (DMOPT Subdeck)

The optional keyword cards in the DMOPT subdeck are as follows.

- DMOPT--Identifies the subdeck type as the Data Management Subdeck
- Specification of editing options for Observations Working File creation
  - ACCREJ--Specifies the number of accept or delete cards that follow
  - Aƀƀƀ****--Specifies acceptance criteria for editing observations (**** is a four-letter station acronym)
  - Dƀƀƀ****--Specifies deletion criteria for editing observations
  - MAXOBS--Sets the maximum number of observations to be accepted from the 60-byte observation tape or data base
  - SAMPLRTE--Specifies acceptance criteria for editing observations by time
- Generation of Statistical Output Reports (SORs)
  - MIXPAIR--Mixes a pair of SOR categories as a single SOR category
  - NOIS****--Sets noise determination criteria

- NOIMIN--Sets minimum valid points to perform noise analysis
- SELOUT--Generates the SORs and tracking data validation plot file (FT62)
- SORINPUT--Sets SOR editing parameters for SOR categories
- SORVALID--Sets SOR data validity overrides

• Change the standard deviation for observations

- CHWT****--Sets the input observation noise standard deviation for 60-byte data when the SOR is requested and for TDRS ground transponder data in the 60-byte format when the SOR is not requested.
- OBSDEV--Sets the input observation noise standard deviation for either 100-byte data, or 60-byte data (other than TDRS ground transponder data) when the SOR is not requested.

• Retrieval of data base force model, integration, elements, and station data definition

- SATGROUP--Activates satellite grouping capability
- WORKATM--Builds Atmospheric Density Working File
- WORKCON--Builds Astrodynamic Constants Working File
- WORKELS--Builds Elements Working File
- WORKINT--Builds Integration Coefficients Working File

- WORKIONO--Builds Ionospheric Refraction Working File
- WORKGEO--Builds Station Geodetics File
- WORKMAN--Builds Impulsive Maneuvers Working File
- WORKSECT--Builds Flight Sectioning Working File
- WORKTCOR--Builds Time Conversion Coefficients Working File

/*******1
/*******2

Station Cards 1 and 2, respectively, which define station type, position, and some station-dependent data

- Creation of permanent or temporary SLP Files
  - SLPBODY--Selects the central and noncentral bodies for generating the SLP Ephemeris File
  - SLPDEG--Sets degree of curve fit for SLP bodies
  - SLPFILE--Indicates source of data to be used in creating the SLP Working File
- Specification of parameters for real-time (partial batch) request for data currently being collected within TCOPS
  - RTSATID--Specifies all satellite IDs for which partial batch data are to be requested
  - RTPARAMS--Specifies the partial batch request parameters
  - RSTA****--Specifies the tracing station for which partial batch data are to be requested
  - RSYS****--Specifies the tracking system for which partial batch data are to be requested

3.2.1.2.2 Optional Orbit Generator Keywords (OGOPT Subdeck)

The optional keyword cards in the OGOPT subdeck are as follows.

- OGOPT--Identifies subdeck type as Orbit Generation Subdeck
- Change force model constants from default values
  - ATMOSDEN--Defines format of atmospheric density table (DODS or GTDS)
  - ATTANG1--Sets satellite spin axis right ascension or yaw angle polynomial coefficients
  - ATTANG2--Sets satellite spin axis declination angle or pitch angle polynomial coefficients
  - ATTANG3--Sets satellite spin axis roll angle polynomial coefficients
  - BDROTATE--Sets rotation rates of planetary bodies
  - BODYRAD--Sets equatorial radii of planetary bodies
  - CNM--Sets geopotential or lunar potential harmonic coefficients, $C_{n,m}$, options and values (see Reference 2, Section 4.3)
  - COVARNC--Stores upper triangle of the a priori state covariance matrix
  - DECLVAR--Sets standard deviations of declination or pitch coefficients
  - DRAGCOF--Sets polynomial coefficients of ρ_1 drag parameter by flight section
  - DRAGPAR--Updates aerodynamic drag parameters and sets drag partial derivatives switch

- DRAGPOLY--Sets the number of polynomial coefficients of ρ_1 to be solved for by flight section (see Section 4, keyword DRAGPAR for definition of ρ_1)
- FLATCOEF--Sets the inverse of the flattening coefficients of the planetary bodies
- GMCON--Sets gravitational constants for the planetary bodies
- HARMONIC--Reads geopotential or lunar potential table
- IMPULSE--Sets impulsive maneuver velocity increments
- LNDPAR--Sets data for processing landmark observations
- MANMASS--Sets satellite mass required to compute an impulsive maneuver
- MANTIME--Specifies the time of the impulsive maneuver
- NPQPAR--Sets Brouwer drag coefficients, $N_{p,q}$ values, and solve-for switches
- POTFIELD--Retrieves geopotential harmonic coefficients
- RAPRIME--Sets right ascension of the prime meridian of specified planetary bodies
- RATIME--Sets the time associated with the right ascension on the RAPRIME keyword card
- ROLLVAR--Sets a priori standard deviations of roll coefficients for an Earth-stabilized spacecraft

- RTASCVAR--Sets a priori standard deviation of right ascension or yaw coefficients
- SCPARAM--Sets spacecraft area, mass, and radius
- SCPARAM2--Sets cylindrical spacecraft parameters and paddle configuration
- SNM--Sets geopotential or lunar potential harmonic coefficients, $S_{n,m}$, options and values (see Reference 2, Section 4.3)
- SOLRDPAR--Updates solar radiation parameter, C_R, and sets solar radiation partial derivatives switch
- SPHERE--Sets sphere of influence for the planetary bodies
- TITLE--Allows input of various titles
- THRSTCOF--Sets thrust magnitude coefficient data
- THRSTVAR--Sets variance of thrust accelerations, vehicle right ascension and declination
- THSOFNO--Set thrust solve-for flags
- TH TAB1, TH TAB2 } Define tables from GMAN output tables (mass/thrust)

• Change force model options (numerical and semi-analytic type theories only)

- APOFOCAL--Defines the sectioning parameter to cross at apofocal distance
- AUTOFORC--Sets the option for automatic force model selection

- AVERAGE--Sets variation of parameters numerical averaging option
- CBODY--Sets central body indicators by flight section
- DISTCB--Sets distance from the current central body at which sectioning is to occur
- DISTNCB--Sets distance from the next central body at which sectioning is to occur
- DRAG--Sets force model drag option for each flight section
- MAXDEGEQ
- MAXORDEQ

  Set the maximum degree and order, respectively, for evaluating the nonspherical potential of the central body for the equations of motion
- MAXDEGVE
- MAXORDVE

  Set the maximum degree and order, respectively, for evaluating the nonspherical potential of the central body for the variational equations
- MAXSECT--Sets number of flight sections
- NCBODY--Sets noncentral bodies for each section
- PICBIAS--Sets landmark camera/picture biases options
- POLAR--Sets polar motion option for each section
- RCACB--Defines sectioning parameter radius of closest approach for the central body
- RCANCB--Defines sectioning parameter radius of closest appraoch for the next central body

- SOLRAD--Sets force model solar radiation option for each section
- SPHINF--Sets indicators for ending the current section if the sphere of influence changes
- THRUST--Sets finite thrust option for each section
- TOF--Sets time of flight at which sectioning is to occur
- TWOBODY--Sets two-body option in the force model for specified section

• Set options for the computation of partial derivatives

- ATTPAR--Sets the number of right ascension and/or declination partial derivatives to be computed
- CNM
- SNM

  Set options to compute position and velocity partial derivatives with respect to $C_{n,m}$ and $S_{n,m}$
- DRAGPAR--Sets option to compute position and velocity partial derivatives with respect to aerodynamic drag model parameters
- SOLRDPAR--Sets option to compute position and velocity partial derivatives with respect to solar radiation model parameters
- STATEPAR
- STATETAB

  Set options to compute position and velocity partial derivatives with respect to initial state parameters

- THRSTPAR--Sets options to compute position and velocity partial derivatives with respect to thrust magnitude parameters

• Change numerical integration options and tolerances

- INTEG--Sets numerical integration parameters, type, and order

- INTMODE--Sets section-dependent stepsize control switch

- LOWBOUND
- NOMBOUND
- UPBOUND

  Set lower, nominal, and upper truncation error tolerances, respectively, for stepsize control

- MEANEL--Sets osculating-to-mean element conversion option for the averaging orbit integration

- RESTART--Sets the numerical integration starter option

- SHELLRAD--Sets radial distances and stepsize for integration when using the shell mode

- STEPSIZE--Sets integration stepsize by flight section

- TIMREG--Sets section-dependent time-regularization parameter

- TIMREGDV--Sets section-dependent time-regularized stepsize parameter

- TOLER--Sets various integration tolerances

• Change orbit generator output options

- EPHQLCRT--Requests printout of selected vectors from EPHEM or ORB1 Files

- INTEROUT--Sets intermediate output options for orbit generator
- OUTBODY--Sets additional optional output reference bodies by flight section
- OUTOPT--Sets output options for ephemeris files
- TIMES--Sets reference date for integration
- VAREPHEM--Sets the time intervals between data points of variable step EPHEM Files by satellite height

3.2.1.2.3 Optional DC Keywords (DCOPT Subdeck)

The optional keyword cards in the DCOPT subdeck are as follows:

- DCOPT--Identifies subdeck type as DC Subdeck
- Aƀƀƀ****--Specifies acceptance criteria for editing observations (**** is a four-letter station acronym)
- ACCREJ--Specifies number of accept or delete cards that follow
- ATMOSEDT--Sets atmospheric editing switch and limits for Tracking and Data Relay Satellites (TDRSs) and Applications Technology Satellites (ATSs) only
- CMCORR--Sets antenna offsets from spacecraft center of mass
- CONSIDER--Invokes "consider" mode of the DC
- CONVERG--Sets DC Program iteration control variables
- CWEIGHT--Sets weighting factor constants
- Dƀƀƀ****--Specifies deletion criteria for editing observations (**** is a four-letter station acronym)

- DCFDR--Sets option to output osculating Keplerian or Brouwer mean elements in the Orbital Elements Report
- EDIT--Sets observation edit parameters
- ELLMODEL--Defines the ellipsoid model
- INTEROUT--Permits printing of intermediate output
- MODDC--Indicates use of the Marquardt algorithm
- OASENSOR--Sets attitude sensor data values and options
- OBSCORR--Sets observation correction parameters
- PASSTIME--Defines a pass for pass-dependent biases
- PRINTOUT--Sets Observation Residual Report frequency and printer plot options
- RAMB****--Overrides small range ambiguity for SRE data (asterisks represent station acronym)
- RAMBOPT--Selects SRE range ambiguity computation option
- SAVE--Sets option to save observation working data files
- SSCOVAR--Sets the upper triangle of covariance matrix of an ATS relay satellite (see Section 3.2.2.24)
- SSELEM1--Defines three elements of an ATS relay satellite (see Section 3.2.2.24)
- SSELEM2--Defines three elements of an ATS relay satellite (see Section 3.2.2.24)

- SSEPOCH--Sets epoch of ATS relay elements (see Section 3.2.2.24)
- SSOPT--Sets orbit generator type and spacecraft parameters for an ATS relay satellite (see Section 3.2.2.24)
- TRACKELV--Sets minimum allowable elevation angle for each tracking system
- TRNDLY--Sets transponder delay table
- /*******--Station cards 1, 2, 3, 4, 5, and 6 define station-related information

3.2.1.3 Initial Elements and Epoch

The following methods are provided for inputting initial elements and epoch into a DC Program run:

- Punched card input
- 24-Hour Hold Elements File
- GTDS Permanent Elements File
- Elements from a previous run
- Elements epoch advance
- PTOF

These methods are discussed in the following sections.

3.2.1.3.1 Input Elements via Card Input

The keywords ELEMENT1, ELEMENT2, and EPOCH allow punched card input of initial elements. (Also see Section 4.)

3.2.1.3.2 Input Elements via GTDS Files

Elements from a DC Program run can be stored in one of the two GTDS element files, the 24-Hour Hold Elements File or the GTDS Permanent Elements File. These elements can subsequently be used as input to a DC Program run. In this

case, a user must supply, in a DMOPT subdeck, the WORKELS keyword card that defines the type of file and the element set number. For further description of this information, see WORKELS in Section 4. When elements are supplied through the WORKELS keyword card, the ELEMENT1 and ELEMENT2 keyword cards are not required.

3.2.1.3.3 Elements From a Previous Run

Elements resulting from previous execution of a GTDS program (for example, in a previous DC Program execution) may be used as DC Program initial elements by placing the word INPUT or OUTPUT in the elements-source field of the CONTROL card (see Section 2.1). When the elements are supplied through COMMON, the ELEMENT1, ELEMENT2, and EPOCH keyword cards are not required.

3.2.1.3.4 Elements Epoch Advance

The concept of elements epoch advance is used to propagate (i.e., advance) the elements from the given epoch at T_0 to another epoch at T_1 (the epoch needed for the DC Program run). The elements T_1 then become the initial elements for the DC Program run. The two methods available to the user to do this are as follows.

1. The DC Program automatic epoch advance option can be invoked by supplying T_1 in columns 60 through 80 of the DC EPOCH keyword card. The value T_1 must assume the packed date from YYMMDDHHMMSS.SSSS, while T_0 and the associated elements are obtained through any of the methods listed in this section. The state is initialized at T_0, and the EPHEM Program is called to propagate the state to T_1 using orbit generator options specified in the input, prior to starting the DC Program.

2. A manual advance, employing an EPHEM Program input deck followed immediately by a DC Program input deck, may be used. The EPHEM case is executed with the OUTPUT mandatory keyword card containing T_1 as the end time. The DC case is then executed with the word OUTPUT in columns 41 through 48 of the CONTROL card (see Section 2.1). As a result, the DC Program uses the elements at time T_1 (computed in the EPHEM Program) as initial elements. The DC case will then require no ELEMENT1, ELEMENT2, or EPOCH keyword cards, because element and epoch information is available to the DC Program run through COMMON blocks.

3.2.1.3.5 Elements From a PTOF

Initial elements may be extracted from a PTOF. In this case, a user must supply a WORKELS keyword card in the DMOPT subdeck. The FRN of the PTOF must be specified, and must be 71, 72, or 73. Either the PTOF level number or the epoch time (or both) must be specified on the WORKELS keyword card. If only the level number is specified, the epoch vector from that level is extracted. A level number of -1 may be specified if the epoch time is specified. In this case, the level number with the latest possible start time is accessed. See WORKELS in Section 4 for further description of this information. When elements are extracted from a PTOF, the ELEMENT1, ELEMENT2, and EPOCH keyword cards are not required.

3.2.1.4 <u>Observation Sources</u>

In GTDS the observations can be obtained from one or more sources. The source(s) and the start and end times of the observation span to be used are specified via the OBSINPUT

mandatory keyword card. All observations in the timespan will be used unless a detailed edit is specified. The observations used are stored in a GTDS Observations Working File. The OBSINPUT keyword card, described in Section 4, specifies the acceptable sources, their timespans, and corresponding FRNs. In addition, if the observation source is from the 60-byte data base, the satellite grouping option, specified via the SATGROUP keyword card, is available. This option enables the user to treat a group of different satellites as one satellite.

Another option available to the user is the capability to input 60-byte tracking data in a near real-time mode. Called 60-byte partial batch data, these observations allow orbit determination or tracking data validation to be performed using observations that are currently being accumulated by the data collection program of TCOPS and that have not yet been placed on the 60-byte data base.

3.2.1.5 Orbit Generator Type and Associated Parameters

The ORBTYPE mandatory keyword card provides basic information regarding the orbit generator and associated options that will be used to provide the ephemeris data required by the DC process. The orbit generator type is in the first integer field of this keyword card. Neither a pregenerated ORBIT File (option 6 in card columns 9 through 11) nor a PTOF (option 11) can be used in a single satellite DC Program run. Other parameters on the ORBTYPE keyword card provide basic information on the orbit generator type and integration parameters. The integration coordinate system can be either mean equator and equinox of 1950.0 or true-of-reference date. The reference date can be either epoch or the date input on a TIMES keyword card in an OGOPT

subdeck. (For detailed keyword card descriptions, see Section 4.)

The force model options generally used in the DC Program are the standard GTDS default options. GTDS defaults to an Earth-centered system with Sun, Moon, and a 4-by-4 gravity field in the force model. However, if a user wants to modify any of the parameters used in the orbit generator, an OGOPT subdeck with the proper optional keyword(s) is required (see Section 3.2.1.2.2). Types of parameters that can be modified are force model constants and options, partial derivative options, and integration options. (For descriptions of orbit generator keywords, see Section 3.2.1.2.2.) For example, to modify the Earth's gravitational constant μ to any real value R, the following card is required in a OGOPT subdeck:

Columns	1 - 8	11	18 - 38
	GMCON	1	R

The orbit generator is basic to the DC process. Incorrect values for orbit generation parameters can easily produce erroneous results. Therefore, the user must be familiar with the EPHEM Program described in Section 3.1. Also, note that many of the orbit generator parameters can be changed through the data management subdeck, DMOPT, which controls working file generation (see Section 3.8).

3.2.1.6 Flight Sectioning

The multiple flight sectioning capability, described for the EPHEM Program in Section 3.1.12, is available to the DC Program. DC Program runs usually consist of a single flight section wherein the central body and force model used are

those in effect for section one. Multiple section DC Program runs can, however, be specified as described in Section 3.1.12.

3.2.1.7 Modified DC Program (Marquardt Algorithm)

Usually DC Program runs employ a Bayesian weighted least squares estimation algorithm. However, an available option in GTDS allows use of the Marquardt algorithm. This algorithm couples a direct gradient method with the indirect weighted least squares method to enhance convergence when the initial conditions are poorly defined. To enter this enhanced differential correction mode in GTDS, it is necessary to use the keyword card MODDC (Modified DC Program). The initial values of the constants entered on this card modify the convergence characteristics of the differential correction process. Although the values of the input constants are not critical for convergence, to achieve convergence within a small number of iterations, it is necessary to choose the initial estimates of these constants judiciously (see Reference 1).

3.2.1.8 Solve-For Parameters

Solve-for parameters are those parameters that are to be estimated in a DC Program run. The two types of such parameters are dynamic solve-for parameters and local solve-for parameters.

Dynamic solve-for parameters are those that are implicit in the equations of motion; they include the following:

- Spacecraft state vector at epoch
- Aerodynamic force parameter including a segmented ρ_1 parameter (see DRAGPAR in Section 4 for a definition of ρ_1)

- Scale factor on the solar radiation acceleration
- Gravitational harmonic coefficients
- Thrust model parameters
- Attitude model parameters

Local solve-for parameters are those that are implicit in the observation models; they include the following:

- Tracking station locations
- Observation biases (by pass)
- Station timing biases (by pass)

General restrictions on specifying solve-for parameters are as follows.

1. The maximum number of dynamic solve-for parameters is 20. If dynamic parameters are being considered [i.e., parameters being considered for statistical purposes but not being estimated (see also Section 3.2.1.9)], then the combined maximum number of dynamic solve-for and dynamic consider parameters is 20.

2. The maximum number of solve-for parameters is 50. If any parameters are being considered, then the combined maximum number of solve-for plus consider parameters is 50.

3. Analytic orbit theories can solve only for state parameters and local solve-for parameters, except that the Brouwer-Lyddane theory can solve for up to 14 $N_{p,q}$ drag coefficients.

For nonstate dynamic solve-for parameters, the applicable numerical orbit generator will integrate the variational equations X/P, where P is the parameter. A related set of

input, the a priori covariance matrix for the solve-for parameters, is discussed in Section 3.2.1.10.

3.2.1.8.1 Dynamic Solve-For Parameters

By default in a DC Program run, the Cowell orbit theory will be used and the six Cartesian elements X_0, Y_0, Z_0, $\dot{X}_0$, $\dot{Y}_0$, Z_0 will be solved for. If a user wants to modify this basic set or to solve for other dynamic parameters, an OGOPT subdeck with the proper keyword cards (described in the following subsections) must be supplied. The nonstate dynamic solve-for parameters discussed below are only valid with Cowell or VOP type 8 (Keplerian VOP) orbit theories. Only state dynamic parameters can be solved for when the observation source is PCE data.

3.2.1.8.1.1 State Elements

GTDS can solve for from one to six state parameters from one of the following state parameter sets (see Appendix A):

- Cartesian (X_0, Y_0, Z_0, X_0, Y_0, Z_0)
- Keplerian (a, e, i, Ω, ω, M)
- Spherical (α, δ, υ, β, r, V)
- DODS unknowns (X_1, X_2, ..., X_9, X_{19})
- Brouwer mean elements

The Cartesian set is solved for in a DC Program run by default except when a Brouwer or Brouwer-Lyddane theory is used. The default for those cases is the first six DODS unknowns. To change the state parameter set, a user must supply a STATEPAR keyword card with the appropriate value in column 11. If the set is DODS unknowns, then the type of orbit orientation about the angle ϕ (phi) is defined in column 17. If a 1 is input, the angle also must be input in columns 18 through 38.

For a given state parameter set, GTDS will solve for all six parameters (the first six DODS variables). To solve for a subset of the state parameters set, a STATETAB keyword card with the values indicating the subset must be supplied. (See Table A-1 in Appendix A for valid values.)

For example, to solve for only the Keplerian eccentricity and inclination, the following two keyword cards must be supplied in an OGOPT subdeck:

Columns 1 - 8	11	14
STATEPAR	2	
STATETAB	2	3

To solve for no state parameters, the user must include STATEPAR and STATETAB keyword cards with a zero (0) in the integer fields.

3.2.1.8.1.2 Drag Coefficient With Segmentation (ρ_1)

The coefficient, $_1$, in the aerodynamic drag term of the force model can be estimated via the use of the DRAGPAR key word card. For example, to solve for $_1$, the following input is provided in an OGOPT subdeck:

Columns 1 - 8	11
DRAGPAR	1

This will provide a constant value for ρ_1 with one section. If ρ_1 segmentation is designed with more than one section, then the keyword cards DRAGCOF and DRAGPOLY must be included with the appropriate information. An example with two sections and a linear form for ρ_1 would be coded as follows:

Columns 1 - 8	11	14	18	39
DRAGPAR	1			
DRAGPOLY	1	2	2.0	2.0

Thus, the EPHEM Program will numerically integrate the variational equations for $\partial\ddot{X}/\partial\rho_1$, and, hence, compute the partial derivatives $\partial X/\partial\rho_1$ and $\partial\dot{\bar{X}}/\partial\rho_1$ at observation time.

When the DRAGPAR keyword is used, the drag source will be invoked for Section 1 of the flight if drag has not been invoked in the force model. The spacecraft area and mass must be supplied via a SCPARAM keyword card in an OGOPT subdeck. The DRAGPAR keyword card is also used to modify any of the five drag parameters C_{D_o}, ρ_2, ρ_3, ρ_4, and N. (For more detail, see the DRAGPAR, DRAGPOLY, and DRAGCOF keyword card descriptions in Section 4.)

3.2.1.8.1.3 Solar Radiation Coefficient (C_r)

The solar radiation coefficient, C_r, in the solar radiation term of the force model can be estimated via the SOLRDPAR keyword card. For example, to solve for C_r, the following input is provided in an OGOPT subdeck:

Columns 1 - 8	11
SOLRDPAR	1

Thus, the EPHEM Program will numerically integrate the variational equations for $\partial\ddot{\bar{X}}/\partial C$ and, hence, compute the partial derivatives $\partial\bar{X}/\partial C_r$ and $\partial\dot{\bar{X}}/\partial C_r$ at the observation time.

When the SOLRDPAR keyword is used, the solar radiation force will be invoked. The spacecraft area and mass must be supplied via a SCPARAM keyword card in an OGOPT subdeck. The keyword card SOLRDPAR is also used to modify the default value of C_R.

3.2.1.8.1.4 Harmonic Coefficients ($C_{n,m}$ and $S_{n,m}$)

The EPHEM Program force model allows for a 21 x 21 potential field for the nonspherical gravitational acceleration of the Earth or the Moon. In GTDS, up to 20 harmonic coefficients can be estimated. These estimated coefficients, $C_{n,m}$ and $S_{n,m}$, must (1) be used in the force model (e.g., the keyword cards MAXORDEQ and MAXDEGEQ must indicate an order and a degree for the gravitational harmonics in the equations of motion at least as great as the order and degree of the coefficient being estimated), and (2) be used in the variational equations (e.g., the keyword cards MAXORDVE and MAXDEGVE must indicate an order and degree for the gravitational harmonics in the variational equations at least as great as the order and degree of the coefficient being estimated). (See Reference 2, Section 4.3, for definition of $C_{n,m}$ and $S_{n,m}$.)

In standard notation for $C_{n,m}$ and $S_{n,m}$:

m is the order (thus, MAXORDEQ, MAXORDVE)
n is the degree (thus, MAXDEGEQ, MAXDEGVE)

Once the terms have been indicated as being used in the orbit generator, the specific coefficients to be estimated can be input via the CNM or SNM keyword card. One card is required for each coefficient; for example, to solve for $C_{2,0}$ in an Earth-centered orbit, the following input is provided:

Columns	1 - 8	11	14	17	60 - 80
	CNM	1	2	0	1.0

The keywords CNM and SNM can also be used to update specific harmonic coefficients.

3.2.1.8.1.5 Thrust Coefficients

The thrust acceleration can be calculated in GTDS using a polynomial of the form

$$A_{THRUST} = a_1 + a_2 t + a_3 t^2 + \ldots + a_8 t^7$$

The values of the thrust polynomial coefficients a_i ($i = 1, 2, \ldots, 8$) are supplied on the THRSTCOF keyword cards. The THRSTCOF cards also include indicators that relate a thrust polynomial to a particular flight section. To solve for these coefficients, the THRSTPAR keyword card must be used.

The capability has been added to GTDS to determine the spacecraft mass and thrust acceleration from previously generated mass and thrust tables. These tables are provided by the non-TCOPS program GMAN. GTDS can use these tables in the EPHEM program to generate a trajectory or in propagating a vector for a DC run.

Additionally, GTDS has the capability to solve for a thrust coefficient during a DC run. This coefficient is used with the thrust table in computing the thrust acceleration.

GTDS keyword cards currently provide a means of input for the first four types of commands listed. The SCPARAM card has been modified to contain an indicator for the use of GMAN tables.

This card will be followed in the parameter file by a series of cards (THTAB cards) defining the tables to be used. Each card includes a start and stop time, stepsize within the table, thrust coefficient for the table, and an interpolation indicator. These cards must appear in chronological order.

Our new keyword card has been added to the OSOPT subdeck; THSOFNO indicates the thrust coefficients that are to be

treated as solve-for variables in a DC run. GTDS will be able to handle up to 20 tables of mass and thrust; each table has a thrust coefficient. The THSOFNO card indicates which ones are solve-for variables.

The following restrictions apply to the use of GMAN tables in GTDS.

- Up to 20 tables can be defined by specifying start and stop times following the SCPARAM card. All tables are taken from a single GMAN working file. If the timespan specified is not included in the working file, an error will occur and the GTDS run will terminate. The tables must be specified in chronological order. The stepsize must be a multiple of the GMAN stepsize.

- A THSTPAR card must be used whenever a THSOFNO card is used.

3.2.1.8.1.6 Attitude Coefficients

The vehicle attitude is characterized by polynomials defining the right ascension and declination of the spin axis as a function of time. These polynomials are of the form

$$S = b_1 + b_2t + b_3t^2 + b_4t^3 + b_5t^4$$

The polynomial coefficients b_i (i = 1, 2, ..., 5) are defined on the ATTANG1 keyword card (for right ascension), on the ATTANG2 keyword card (for declination), and on the ATTANG3 keyword card (for roll). The standard deviations are set on the DECLVAR, ROLLVAR, and RTASCVAR keyword cards. To solve for these coefficients, the ATTPAR keyword card must be used. The coefficients may only be solved for, obviously, when thrust is included in the force model.

3.2.1.8.2 Local Solve-For Parameters

In most DC Program runs, local solve-for parameters are usually not estimated. When required, however, a user can

solve for these local parameters (i.e., station locations, observation biases, and time biases) by including the proper keyword cards in a DCOPT subdeck. Local solve-for parameters can be estimated in conjunction with any orbit generator type. If the observation source is PCE data (see Reference 1), then this option cannot be invoked. If the observation source is attitude sensor data, then only observation biases and time biases can be solved for.

3.2.1.8.2.1 Station Positions

The Earth-fixed Cartesian coordinates of a tracking station can be solved for in a GTDS DC Program run by inputting a Station Card 4; for example, to solve for station ROSS the following input is provided:

Columns	1 - 9	14
	/ROSSƀƀƀ4	1

To solve for the coordinates of N stations, input N cards, where each card represents three solve-for parameters (i.e., the three Cartesian components of the station). GTDS will output the estimates in both Earth-fixed Cartesian and geodetic coordinates.

3.2.1.8.2.2 Station Observation and Station Timing Biases

Biases in station observations or in a station clock can be estimated in GTDS either as a function of satellite pass or independent of pass (i.e., a new bias can be estimated during each satellite pass, subject to the following limitations). To solve for a specific bias, input a Station Card 5 keyword with the bias type (as defined in Appendix A), the number of passes, and the a priori bias value. If biases of minitrack or AZ-EL and X-Y mount angle error model biases are to be solved for, mode and special bias type should also be specified in Station Card 5 keyword (see Section 4).

A PASSTIME keyword card, which applies to all stations, is used to define a pass and is required when solving for more than one pass. The input time (in columns 18 through 38) may be defined either as the maximum time in seconds between two successive observations that are within the same pass or as a specified pass length based on time from the start of one observation (see Section 4).

The fourth integer field on the Station Card 5 keyword card indicates the number of biases to be solved for with respect to the observation bias type (in the third integer field). Suppose a particular satellite orbit contains M passes, and the user has requested that N biases be solved for, where $N \leq M$. Then the first (N-1) biases correspond exactly to the first (N-1) passes, and the Nth bias corresponds to the Nth through Mth passes.

The following example illustrates the use of the PASSTIME keyword card together with the Station Card 5 keyword. Suppose the DC observation span is 24 hours for a satellite whose period is 96 minutes (hence, the observation span covers 15 periods). Let a minitrack station observe the satellite during each satellite period for a maximum time-span of 15 minutes. To solve for an an observation bias for data type with no a priori bias value, then the following input is appropriate:

Columns	1 - 8	9	12-14	15-17	18 - 38	39 - 59
	/*******	5	2	3	0.0	0.0

(where ******* is the alphanumeric station name)

Columns	1 - 8	9-11	18 - 38
	PASSTIME	0	1200.0

In this particular case, three biases, in total, are solved for. The first bias corresponds to the first pass (i.e., first period), the second bias corresponds to the second

pass (second period), and the third bias corresponds to the third through fifteenth passes (third through fifteenth periods). If the following two Station Card 5 keywords are added, then the three biases for observation type m and two timing biases will also be solved for. (The first timing bias corresponds to the first pass, and the second timing bias corresponds to the remaining passes.)

Columns	1 - 8	9	12-14	15-17	18-38	39-59
	/*******	5	3	3	0.0	0.0
	/*******	5	30	2	0.0	0.0

Each new pass generates a new solve-for parameter. Thus, in the above example, eight bias parameters are solved for in the DC Program solution.

3.2.1.9 Consider Parameters

Consider parameters are those model parameters that are known with only limited certainty but are not being estimated. Nevertheless, their uncertainty increases the uncertainty (variance and covariance) of the solve-for variables. The consider mode (i.e., an execution using consider parameters) is invoked by including the CONSIDER keyword card in the DCOPT subdeck. The consider parameters are specified in the same manner as solve-for parameters, and the keyword cards used are described in Section 3.2.1.8. The state parameters will be the only solve-for parameters. Consider parameters can be both dynamic and local and include the following:

- Dynamic Consider Parameters
  - Aerodynamic force parameter
  - Scale factor on the solar radiation acceleration

- Gravitational harmonic coefficients
- Thrust model parameters
- Attitude model parameters

- Local Consider Parameters
  - Tracking station locations
  - Observation biases (by pass)
  - Station timing biases (by pass)

Any parameter designated as a consider parameter must be invoked in the force or observation model (e.g., to consider the drag parameter ρ_1, drag must be included in the force model).

When specifying consider parameters, the combined total number of solve-for plus consider parameters can not exceed 50. Any state parameters specified will be solve-for parameters, and all other parameters will be consider parameters.

If the input observation source is PCE data, only dynamic consider parameters can be considered. If the observation source is attitude sensor data, only observation biases and timing biases can be considered.

3.2.1.10 Covariance Matrix

For a DC Program run, the a priori uncertainty of the solve-for and consider parameters is input via the covariance matrix. In GTDS the a priori values of all elements of the inverse covariance matrix default to zero. If a nonzero inverse a priori covariance matrix is desired, the nonzero elements of the covariance matrix must be input. Section 3.2.1.10 describes the input of the matrix in two parts, state elements and nonstate elements.

3.2.1.10.1 State Covariance Matrix

A COVARNC keyword card in the OGOPT subdeck is required to input the state covariance matrix. Because this matrix is

symmetric, only the upper triangle, as shown below, need be input

$$\begin{bmatrix} m_{11} & \cdot & \cdot & \cdot & \cdot & m_{16} \\ & m_{22} & \cdot & \cdot & \cdot & m_{26} \\ & & \cdot & \cdot & \cdot & \cdot \\ & & & \cdot & \cdot & \cdot \\ & & & & \cdot & \cdot \\ & & & & & m_{66} \end{bmatrix}$$

The integer fields on this keyword card contain row and column positions (in packed form) of the matrix elements in the corresponding real fields of the keyword card. For example,

Columns	1 - 8	9-11	12-14	15-17	18-38	39-59	60-80
	COVARNC	12	34	66	1.	2.	3.

then m_{12} = 1., m_{34} = 2., m_{66} = 3., and m_{ij} = 0. for all other combinations of i, j = 1, ..., 6 and $i \leq j$. Thus, to establish a full matrix, 7 COVARNC keyword cards are required to define the 21 elements of the upper triangle of the matrix.

3.2.1.10.2 Nonstate Covariance Matrix

Nonstate elements are the drag coefficients, solar radiation coefficients, gravitational harmonic coefficients, thrust coefficients, right ascension/declination coefficients, station positions, observation biases, and timing clock biases. For these elements, only the square roots of the diagonal terms of the covariance matrix can be input (i.e., the standard deviations).

A standard deviation is input on the keyword card that specifies the parameter(s) to be solved for or considered. In particular, the keyword cards are as follows.

- DRAGPAR for the drag coefficient
- SOLRDPAR for the solar radiation coefficient

- CNM or SNM for the gravitational harmonic coefficients
- THRSTPAR for thrust coefficients and attitude coefficients
- Station Card 4 (/*******4) for station position
- Station Card 5 (/*******5) for observation and timing clock biases

For example, if the solar radiation coefficient is being estimated, then columns 60 through 80 of the SOLRDPAR keyword card contain the a priori standard deviation.

3.2.1.11 Variational Equations for State Parameters

Whenever a dynamic parameter P is being solved for or considered, numerical solution of the variational equations for $\partial X/\partial P$ and $\partial \dot{X}/\partial P$ is generally required. However, in GTDS the user has the option to use an analytic solution if the parameter P is a state variable, even though the orbit theory is nonanalytic. This is done by including in the OGOPT subdeck a STATEPAR keyword card with 1.0 in card columns 39 through 59. In this case, the analytical partial derivatives are computed using the integrated state in a two-body analytic solution.

With this option, other dynamic parameters can still be estimated (or considered), in which case, the orbit generator will numerically integrate the variational equations with respect to these parameters. If the orbit generator is Variation of Parameters and the Keplerian elements are solved for, the numerical variational equations can be applied.

Otherwise, only the analytic option can be used. For analytic orbit generators such as Brouwer, only the analytic solution to the variational equations can be used, and only dynamic state parameters can be included in the DC Program.

3.2.1.12 Tracking Stations and Ellipsoid Models

The tracking data used by GTDS are initially obtained by the National Aeronautics and Space Administration's (NASA's) global network of tracking stations and transmitted to the NASA GSFC. At GSFC these data are preprocessed and eventually transmitted to GTDS by one or more of the sources described on the OBSINPUT keyword card. GTDS determines which stations performed the tracking and builds a station geodetics working table by extracting from the Tracking Station Geodetics File pertinent stations data (height above the reference ellipsoid, geodetic latitude, longitude, the reference ellipsoid model number, station type, antenna offset, north/south and east/west deflection, transmitter frequency, and catalog number). Thus, in a typical DC Program run, station data are obtained from GTDS permanent files, and the user need not input these data.

In case the required station geodetics are not included in the permanent file, or if the user wishes to modify the station geodetics, user-supplied punched card input capability has been provided in GTDS. Sections 3.2.1.12.1 and 3.2.1.12.2 describe this input capability.

Stations in GTDS can be referenced to different ellipsoids (see Reference 2), or the basic ellipsoid can be modified. This is explained in Section 3.2.1.12.3.

3.2.1.12.1 Inputting a New Station in a DC Program Run

If the station is not in the permanent file, a Station Card 1 keyword (/*******1, where ******* is the alphanumeric station name) should be included in a DMOPT subdeck. Information provided on this card includes the following:

- Station index number
- Station type

- Geodetic height
- Geodetic latitude
- Longitude (east of Greenwich)

In addition, a Station Card 2 keyword (/*******2) may be input to specify other station-dependent data. If this keyword card is not input, the values will default as follows:

- Ellipsoid model number = 1
- Antenna offset = 0.0
- N/S deflection = 0.0
- E/W deflection = 0.0
- Transmitter frequency = (Function of the station type)

3.2.1.12.2 Modifying Station Geodetics

To modify existing station geodetics, include in a DCOPT subdeck a Station Card 1 keyword and/or a Station Card 2 keyword with the required modifications.

3.2.1.12.3 Ellipsoid Models

GTDS includes the basic ellipsoid model 1 as its default ellipsoid (i.e., semimajor axis of the ellipsoid equals 6378.166 km, and inverse flattening of ellipsoid equals 298.3). This model can be changed by including the ELLMODEL keyword card in a DCOPT subdeck.

In addition, GTDS can optionally have stations in the same DC Program run use different ellipsoid models (e.g., station A may use model 1, and station B may use model 2). To invoke this option, an ELLMODEL keyword card defining model 2 and a Station Card 2 keyword card referencing station B to model 2 are required.

3.2.1.13 Observation Weighting

GTDS computes an observation weight, W, for each observation type according to the following formula

$$W = \rho_F / (C_5\ \sigma_1^2 + C_6\ \sigma_2^2)$$

where ρ_F is a geometric factor defined in Section 3.2.1.13.2, C_5 and C_6 are factors, σ_1 is the a priori observation standard deviation, and σ_2 is the a priori variance obtained from the observation preprocessor. Each of these variables except σ_2 can be modified as described in the following sections.

3.2.1.13.1 Observation Standard Deviation (σ_1)

For each observation type, an a priori observation standard deviation is required. (The nominal values of the standard deviations for various observation types are presented in Appendix A.) These values can be modified by including the OBSDEV or CHWT**** keyword card in a DMOPT subdeck. For example, to modify the standard deviations for Goddard range and range rate (GRARR) S-band range and range rate to R_1 and R_2, respectively, the following input would be appropriate when DODS format data was input:

Columns 1 - 8	9-11	12-14	18-38	39-59
OBSDEV	28	29	R_1	R_2

3.2.1.13.2 Geometric and Gain Factors

The geometric factor, ρ_F, is determined as follows:

Observation Type	ρ_F
Range, elevation, range rate	$C_1 \bullet \sin E + C_2$
Azimuth	$C_3 \bullet \cos E + C_4$
Minitrack direction cosines ℓ, m	$1.0 - O_c^2$
Others	1.0
Default (all types)	1.0

where C_1, C_2, C_3, C_4 are local parameters, E is the computed elevation angle, and O_c is the computed ℓ or m minitrack observation. Additionally, the parameters C_5 and C_6 are used in calculating the weighting. These six factors can be modified by using the CWEIGHT keyword card in a DCOPT subdeck.

3.2.1.14 Observation Data Editing

Input observations that are in the timespan specified on the OBSINPUT card are stored in the Observations Working File. However, these observations can be edited so that only data that satisfy certain a priori specified criteria will be used in the DC process.

The two modes of detailed editing are editing from the source(s) when creating the Observations Working File (mode 1) and editing from the Observations Working File (mode 2). In mode 1, edit keyword cards are included in a DMOPT subdeck, and the edited observations are not stored in the Observations Working File. In mode 2, edit keyword cards are placed in a DCOPT subdeck, and the edited observations remain in the Observations Working File but are not used in the DC solution. In mode 2, however, the weighted observation residuals can be computed and reported by user option.

To edit observations using either the DMOPT or DCOPT subdecks, three keyword cards are included: ACCREJ, Aƀƀƀ****, SAMPRTE (DMOPT only), and Dƀƀƀ****. The *'s represent a 4-character station acronym. The ACCREJ keyword card must precede the Accept and Delete Specification cards (Aƀƀƀ**** and Dƀƀƀ****, respectively) to indicate the number of such cards immediately following. The following edit criteria can be set on either of the edit specification

cards: station acronym (as part of the keyword), satellite object number, edit frequency, observation type, equipment mode, data rate, and edit timespan. (Object number, equipment mode, and data rate apply only to observations input in 60-byte format.) Up to 40 edit specification cards may be input. The maximum number of 60-byte format observations is controlled by the MAXOBS keyword card.

An observation that satisfies edit specifications is accepted or deleted according to the first letter of the keyword card (A or D). If there are no Accept Specification cards in the subdeck, all observations that do not satisfy the delete criteria are accepted. If there is at least one Accept Specification card, all observations that do not satisfy the acceptance criteria are deleted. If an observation satisfies both the accept and delete criteria, it is deleted.

Edit criteria are specified on either the Accept or Delete Specification cards in the following manner:

Columns	Edit Criteria
5-8	Station acronym. The last letter of any station acronym is an indicator of the tracking system (see Section 4). If editing by tracking system rather than the station is required, 'ALLX' is substituted for the station acronym, with X representing a tracker system code.
9-11	Object number
12-14	Edit frequency (every Nth or every ΔT second observation is accepted)
18-38	A packed real word of 4, 8, or 12 digits; every 4 digits represent a combination of GTDS observation type, equipment mode, and data rate. The two leftmost digits represent the GTDS type, the third represents the equipment mode, and the last represents the data rate. If mode and data rate editing is not required, zeros are filled in.
39-59	Start time of edit span
60-80	End time of edit span

Specific examples of observation editing are given below (see Section 4 for more detailed formats):

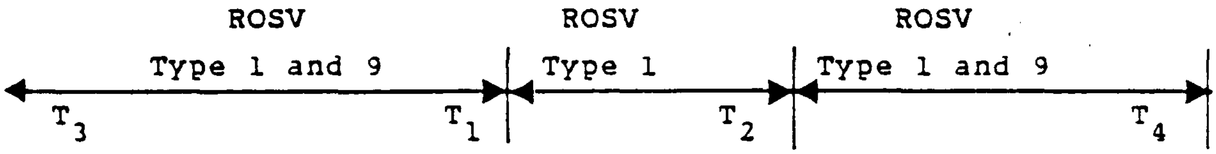
1. Delete all range rate observations received from station ROSV from time T_1 to T_2.

Columns	1-8	19-38	39-59	60-80
	DƀƀƀROSV	900.0	T_1	T_2

2. Accept all range and range rate observations received from station ROSV from time T_3 to T_4.

Columns	1-8	19-38	39-59	60-80
	AƀƀƀROSV	9000100.0	T_3	T_4

3. Assuming T3   T1 and T2   T4, and if examples 1 and 2 are combined, then the following observations are accepted:



4. Accept every 5th USB30 observation of types 10, 11, or 13 within the observation timespan.

Columns	1-8	12-14	19-38	39-59	60-80
	AƀƀƀALL3	5	100011001300.0	0.0	0.0

5. Accept every 50-second USB observation of types 10, 11, or 13 within the observation timespan.

Columns	1-8	12-14	19-38	39-59	60-80
	AƀƀƀALL3	-99	100011001300.0	0.0	0.0
	SAMPLRTE		50.		

3.2.1.15 <u>Dynamic Mathematical Editing</u>

Dynamic mathematical editing deletes an observation from the DC process during an iteration if the computed elevation angle is less than a preset minimum, or a weighted residual

exceeds a statistical deviation. The observation is used in the next iteration unless it again fails the test(s). In a DC Program run, all these tests are generally performed. A user can modify the default test values, as described in the next two sections.

3.2.1.15.1 Elevation Angle Editing

The minimum allowable elevation angle is 0.0 degrees for all tracking systems by default. To modify this value for selected tracking systems, TRACKELV keyword card(s) containing tracking system numbers and their minimum elevation angles should be input in a DCOPT subdeck.

3.2.1.15.2 Root Mean Square (RMS) Editing

In GTDS each observation is rejected if its weighted residual WR, exceeds a statistical deviation, SD, computed as follows:

$$WR = W\ (O - C)$$
$$SD = N \bullet RMS_{i-1} + RMS_{ADD}$$

where W = the square root of the observation weight

O = the input observation

C = the computed observation

RMS_{i-1} = the standard deviation from the previous iteration

N = the sigma multiplier

RMS_{ADD} = the added factor

The default values of N and RMS_{ADD} are 3.0 and 0.0, respectively. The WR/SD comparison is sometimes called the 3σ test. The default values of N and RMS_{ADD}, as well as the initial RMS, which is equal to 1.E + 03 by default, can be modified via the EDIT keyword card.

By modifying these values, the user can effectively accept all observations in a DC process (e.g., changing N or

RMS_{ADD} to 1.E + 7 would cause virtually all observations to be accepted). By making the initial RMS smaller, the DC Program would be made more selective in accepting observations during the first iteration.

3.2.1.16 Tracking Data Observation Corrections

Tracking data observations can be corrected for ionospheric refraction, tropospheric refraction, transponder delay, station antenna mount error, spacecraft antenna offset, range ambiguity, and signal propagation time delay. This latter correction is frequently referred to as light time correction. Generally these corrections are not performed in a DC Program run. Table A-3 in Appendix A defines the observation types for which each of these corrections is applicable. To invoke these corrections, the user includes in a DCOPT subdeck the OBSCORR, Station Card 6, TRNDLY, RAMBOPT, RAMB****, and/or CMCORR keyword cards. The OBSCORR keyword card is required to invoke ionospheric refraction, tropospheric refraction, transponder delay, station antenna mount, or signal propagation corrections; the Station Card 6 is optional. In addition, TRNDLY is used to define the transponder delay table, RAMBOPT and RAMB**** are used to invoke the range ambiguity correction, and CMCORR is used to invoke the spacecraft antenna offset correction.

Information contained on the OBSCORR keyword card includes the frequency at which observations are corrected, the iteration on which to commence the corrections, which corrections are to be made, and the minimum elevation angle for refraction corrections. The frequency at which observation corrections are updated is specified by an integer n, which denotes that the corrections will be recalculated every nth iteration as a function of the updated state on that iteration. The default value of n is zero, which implies that no

corrections will be made. The first iteration on which observation corrections will be computed is specified by the integer i, which denotes that the corrections will be made for the first time on the ith iteration. The default value of i is 1. Thus, the corrections will be started on the ith iteration and updated every nth iteration thereafter.

The first real field of the OBSCORR keyword card is a packed word that specifies the corrections to be made for all stations. If it is not input, a Station Card 6 keyword must be input. The packed word, denoted IJKLM, is defined as follows:

Letter	Description	Action
I	Light time correction	= 1, yes; = 2, no
J	Ionospheric refraction correction*	= 1, yes; = 2, no
K	Tropospheric refraction correction	= 1, yes; = 2, no
L	Antenna mount correction	= 1, yes; = 2, no
M	Transponder delay correction**	= 1, yes; = 2, no

For example, a value of 11222.0 specifies that light time and ionospheric refraction corrections are to be computed for all stations, but that tropospheric refraction, antenna mount, and transponder delay corrections are not to be computed.

If the packed word is not input, at least one Station Card 6 keyword must be input, specifying the type of corrections to

*The ionospheric refraction correction option requires the WORKIONO keyword card in a DMOPT subdeck. This card will allow the program to create an ionospheric refraction working file.

**Whenever transponder delay corrections are to be made, the transponder delay table must be input via the TRNDLY keyword card.

be made. There will usually be as many of these keyword cards as there are stations in the DC Program run. (See Station Card 6 (/*******6) keyword in Section 4 for more details.)

The second real field of the OBSCORR keyword card is the minimum elevation angle for refraction corrections that are to be made.

3.2.1.17 Convergence Criteria

In GTDS a DC Program run can be terminat;ed by one of four convergence criteria as follows:

- $$\left| \frac{RMS_B - RMS_P}{RMS_B} \right| < \varepsilon$$

  where RMS_B = the smallest computed RMS
  RMS_P = the predicted RMS of the next iteration
  ε = the iteration convergence ratio, which can be modified via the CONVERG keyword card

- $i > IMAX$

  where i = the iteration number
  IMAX = the maximum number of allowable iterations (which can be modified via the CONVERG keyword card)

- ID > IDMAX

  where ID = the number of consecutive divergent iterations (i.e., $RMS_i > RMS_{i-1}$ for consecutive iterations)
  IDMAX = the maximum number of allowable consecutive divergent iterations (This parameter can be modified via the CONVERG keyword card.)

- $RMS_i \leq RMSMIN$

where RMS_i = the RMS for iteration i

RMSMIN = the minimum allowable RMS, which can be modified via the CONVERG keyword card

In GTDS the default values of the four input parameters are

$$\varepsilon = 0.0001$$
$$IMAX = 15$$
$$IDMAX = 3$$
$$RMSMIN = .3D-5$$

To modify any of these parameters, the CONVERG keyword card containing the values in the proper columns is included in a DCOPT subdeck. For example, to modify ε to 0.005 and IMAX to 6, input the following:

Columns	1 - 8	11	18-38
	CONVERG	6	0.005

The CONVERG keyword card can also be used to invoke a streamlined version of the DC Program called the observed minus computed (O-C) run. In such a run, these convergence criteria are not necessary. (For details, see the keyword card description for CONVERG in Section 4.)

3.2.1.18 Static Biases for Tracking Data or Attitude Sensor Data

Station-dependent biases can be applied to each input observation or to the station time. The observation bias is a function of the observation type (e.g., range, range rate) and is subtracted from the input observation. The timing bias is added to the observation time from a given station.

In GTDS the default values of the biases are zero. To input nonzero biases, use a DCOPT subdeck with a Station Card 5

keyword (i.e., /*******5, where ******* is the alphanumeric station name) with the observation type number or, for time biases, the pseudo time type number 30 in card columns 12 through 14 and the bias value in card columns 18 through 38. If minitrack or AZ-EL and X-Y mount angle error model biases are to be applied, mode and special bias type should also be specified in card columns 60 through 80. For example, to apply a timing bias of 0.01 second and a range bias of 0.5 kilometer to station ROSS (an S-band station) and a zero set bias of 0.0001 for direct cosine angle L of equatorial mode to station ULASKAM (a minitrack station) the following inputs are appropriate:

Columns	1 - 9	13-14	18-38	60-80
	/ROSSbbb5	1	0.5	
	/ROSSbbb5	30	0.01	
	/ULAMbbb5	2	0.0001	1.0

The user may input only one bias per card where the bias applies to the complete DC Program run timespan. The observation types and associated numbers required are given in Appendix A. Minitrack and AZ-EL and X-Y mount angle error model modes and special bias types are given in the description of the Station Card 5 keyword (Section 4). For attitude sensor data, a pseudo station name "SSSSSS" has been defined. This allows the program to add a bias for attitude sensor data.

3.2.1.19 Output Reports

At the beginning of a DC Program run the Initial Conditions Report is always printed. Pertinent Working File Reports will also be printed. By default the iteration reports will also be printed after each iteration. These reports include the Observation Residuals (O-Cs) Report, the Integration Statistics Report, the End-of-Iteration Elements Report, the

Convergence Report, the Variance/Covariance Matrix Report, and the End-of-Iteration Summary Report.

The amount of output can be limited by the user, however, via the PRINTOUT keyword card. This keyword card, when included in a DCOPT subdeck, allows the user to print either some or all of the reports involved. In addition, the O-C Report may be printed only every nth iteration if desired. (See the PRINTOUT keyword description in Section 4 for more deetails.) The PRINTOUT card is also used to generate plots of the observation residuals. If a plot for a particular observation type for a particular station is required, this information can be defined via a Station Card 3 (/*******3).

For users who wish to look at intermediate results of a DC Program run, intermediate output is available in NAMELIST format. This output provides information in terms of program variables. The report is activated from various DC Program subroutines, and output can occur every mth observation of every nth iteration. To invoke intermediate output, the INTEROUT keyword card is used in a DCOPT subdeck. The keyword specifies the DC Program subroutine to be activated and the frequency at which output is to occur. The option to output osculating or Brouwer mean elements in the Orbital Elements Report is controlled by the DCFDR keyword card. (For other output control parameters, see Sections 3.1.13 and 3.1.16.)

3.2.1.20 <u>Data Base Retrieval</u>

Data base retrieval allows a user to modify certain default data values by retrieving the modified values from one of the GTDS permanent files (see Reference 2, Section 10). By this method, different configurations of the default orbit generator can easily be retrieved as opposed to inputting all the required data on cards in an OGOPT subdeck.

Files can be retrieved for the orbit generator functions by inputting a DMOPT or OGOPT subdeck followed by the proper keyword cards. The retrievable permanent files, the associated keywords, and descriptions of the resulting actions are listed in the following tabulation.

File(s)	Keyword	Action
Earth or Lunar Potential Fields	POTFIELD	Retrieve requested potential model
Atmospheric Density Models	WORKATM	Retrieve requested atmospheric density data
Astrodynamic Constants	WORKCON	Retrieve requested model
GTDS Permanent Elements 24-Hour Hold Elements	WORKELS	Retrieve requested elements set or elements set nearest specified epoch
Integration Coefficients	WORKINT	Retrieve requested integration coefficients
Impulsive Maneuvers	WORKMAN	Retrieve requested maneuver number
Flight Sectioning Models	WORKSECT	Retrieve requested sectioning model
Time Conversion Coefficients	WORKTCOR	Retrieve requested time correction data

The specific details of each keyword are given in Section 3.8, Data Management (DATAMGT) Program, and in the Keyword Formats and Descriptions section of Section 4.

Data base retrieval also allows the user to construct working files required for ionospheric refraction correction and station geodetics information used within a DC Program run. These files may be retrieved by placing the following keyword cards in a DMOPT subdeck:

File	Keyword	Action
Tracking Station Geodetics	WORKGEO	Retrieve required station geodetics
Ionospheric Refraction Generalized Coefficients	WORKIONO	Retrieve required ionospheric refraction model

3.2.1.21 SLP Ephemeris File

An SLP Ephemeris File contains data in the form of Chebyshev polynomial coefficients (see Reference 12). These data allow GTDS to compute positions and velocities of up to nine planetary bodies, to transform from selenocentric to selenographic coordinates, to transform from (or to) the mean equator and equinox of 1950.0 to (or from) a true equator and equinox of date system. (See Reference 2 for details of the coordinate and time systems.) These various computations are required for the nonanalytic orbit generators and for the calculation of observations.

A 12-year mean of 1950.0 SLP File (or a TOD SLP File) is automatically available within GTDS. However, there will be instances when these files cannot be used (e.g., when the DC Program timespan is not covered by the files or when the user wishes to modify the planetary bodies for which ephemeris is desired or the degree of the Chebyshev polynomials used in curve fitting).

To create a new file, the user must supply, in a DMOPT subdeck, the SLPFILE keyword card and one or more of the following keyword cards: SLPBODY, SLPCOORD, and SLPDEG. In addition, a JPL DE-19 or DE-96 format planetary ephemeris tape is required. (For further details on the use of these cards and the JPL DE-19 or DE-96 ephemeris tape, see Section 3.8, DATAMGT Program. If the user wishes to create a file, see Section 5 for the JCL requirements.)

3.2.1.22 Saving Elements and Observations Files

During each DC Program iteration, elements can be save in a 24-Hour Hold Elements File, or in the GTDS Permanent Elements File. These elements can then be used in another GTDS run. To save elements during a DC run, the WORKELS keyword card in a DMOPT subdeck is used. Elements will be saved on

the GTDS Permanent Elements or 24-Hour Hold Elements Files upon request, and the element set number will be reported to the user in a GTDS report. Users must supply a password on the WORKELS card to save elements in the Permanent Elements File. (See Section 4 for a description of the WORKELS keyword.)

During each DC Program run, an Observations Working File is created. The file can be saved on tape and then reused in a subsequent DC Program run as a GTDS tape observation input source via the OBSINPUT keyword. To save the Observation Working File, the user includes in a DCOPT subdeck the keyword SAVE with a 1 in column 11. A tape on unit 46 is required in the JCL (see Section 5).

3.2.1.23 ORBIT, ORB1, and EPHEM Files

Satellite ephemeris files in the ORBIT, ORB1, and EPHEM formats can be generated in the DC Program for subsequent used by GTDS or other systems that need satellite ephemerides. The file generation option can only be used when the Cowell or time-regularized Cowell integrator is used. The option is invoked through the OUTOPT keyword card in the OGOPT subdeck. The orbit represented on the file will be the orbit used during the last DC Program iteration. The OUTOPT keyword parameters that define the file type and the file timespan are fully described in Section 4, and associated JCL requirements are given in Section 5.

Care must be taken in selection of the file timespan. Any ephemeris file timespan that lies within the observation timespan can be selected. However, when the user specifies a file timespan that extends outside the observation timespan, certain restrictions exist, based on the final direction of integration during the differential correction process. The orbit generator will complete integration in the forward direction if epoch time is not later than the

latest observation time. If epoch is later than the latest observation time, the final integration direction will be backward. With these points in mind, the following restrictions apply to file timespans:

- For both forward and backward integration, an ephemeris file may not begin earlier than the earliest of either epoch time or the first observation time.
- When the final integration direction is backward, the ephemeris file may not end later than the latest observation time.

3.2.1.24 SOR Generation

A SOR can be generated in a DC Program run through use of the SELOUT keyword card in the DMOPT subdeck. Depending on whether the user input in column 9 of that keyword card is 0, 1, or 2, the SOR will be generated for both the first and last DC iterations, for the first DC Program iteration only, or for the last DC Program iteration only, respectively. Each SOR consists of the following four reports and optional punched output.

3.2.1.24.1 SOR Category Summary

The SOR Category Summary prints the validation statistics of each SOR category encountered in the run. An SOR category is determined by the GTDS observation type, equipment mode, tracking system, and data rate. Receive station acronym and ground transponder index number also may be used in forming SOR categories (see CHWT in Section 4). The data validity check for each category can be overridden by the SORVALID keyword card. The validation statistics of an SOR category are computed on all valid observations of the SOR category that have passed elevation angle editing. The differences between the measurements observed and computed (O-Cs) of these

observations are subjected to a maximum O-C test and an iterative N-sigma test up to L iterations. Observations whose O-Cs fail either of the tests are edited. The means and standard deviations of the O-Cs are computed separately for the edited and unedited observations and are called the validation statistics of the SOR category. The nominal values of the maximum O-C limits for various SOR categories are presented in Table A-4 of Appendix A. The default values for N and L are 3.0 and 6, respectively. These values can be modified by the user via the SORINPUT keyword card in a DMOPT subdeck. In addition, the user can mix a pair of SOR categories as a single SOR category through use of the MIXPAIR keyword card in a DMOPT subdeck. (See the SORINPUT and MIXPAIR keyword card descriptions in Section 4.)

3.2.1.24.2 Detailed Batch Report

A batch comprises observations of the same tracking station, equipment mode, and data rate. Also, the time difference between consecutive observations in a batch, the timespan of a batch, and the number of observations in a batch cannot exceed specified limits. The default limit for the time difference between consecutive observations in a batch is 300 seconds; for the timespan of a batch, 1.E + 6 seconds; and for the number of observations in a batch, 500 seconds.

These values can be modified by the user via the SELOUT keyword card. (See the SELOUT keyword card description in Section 4). All the observations in the DC Program run are sorted into batches according to the above criteria, and each batch is assigned a unique number. A Detailed Batch Report is generated for each batch that tabulates the observations by time. For each observation, the observed value, the O-C, and the associated data quality flags are printed.

Noise determination may be performed during a batch SOR. The minimum percentage of points needed is controlled by the

SELOUT keyword card. Other noise determination criteria are set by the NOIS**** keyword card for each station, where **** is replaced by the station acronym.

Batch calibration and validation statistics are printed after each Detailed Batch Report if the user has not input 0 in column 14 of SELOUT keyword card. The batch calibration statistics are computed the same way as the validation statistics of an SOR category, except that the maximum O-C and N-sigma tests now apply only to observations in a batch. The batch validation statistics are obtained simply by computing the means and standard deviations of edited and unedited observations in a batch for each SOR category. The editing status of each observation was determined when the validation statistics of each SOR category were computed.

3.2.1.24.3 Recap of Batched O-C Summary

This report is a summary of all batch validation statistics printed according to batch number.

3.2.1.24.4 Station O-C Summary

All observations that are received by the same tracking station are grouped together and the mean and standard deviation computed separately for the edited and unedited subsets. The editing performed for the validation statistics computation is used.

3.2.1.24.5 SOR Punched Output

Punched output of the final vector and calibration statistics is available through use of the SELOUT keyword card. The final vector is punched in the same format as the ELEMENT1 and ELEMENT2 keyword cards. The calibration statistics are punched, one card for each batch. Each card containing the batch calibration statistics will also have the following

information: batch number, measure type, satellite international designation, station name, day, hour of day, minutes, and seconds of day. Tracking and Data Relay Satellite System (TDRSS) data will also include the forward and return link TDRSS support identification code, service indicator, bit rate indicator, and Doppler count interval.

3.2.1.24.6 SOR Summary Extract

The user may request a subset of the data from the SOR to be output to a tape file with the use of the SELOUT keyword card. The data that will be output are:

- Batch number
- Time of the observation
- Satellite identification (ID)
- Satellite acronym
- TDRSS forward and return link ID, if applicable
- Doppler count interval, if applicable
- Observed value
- O-C
- Data quality flags
- Minimum elevation

When the SOR extract is requested, a JCL override for FRN 64 is required. (See Section 4 for a description of the SELOUT keyword; see Section 5 for JCL overrides.)

3.2.1.24.7 User Receive Center Frequency Report

Whenever calibration statistics are requested, the User Receive Center Frequency will be formed for all batches containing undifferenced one-way Doppler data. This frequency and associated RMS will appear directly below the noise statistics at the bottom of the SOR batch detail report. Provided that at least one batch has one-way Doppler data, a URC Frequency Recap Report will appear after the Tracker Oriented O-C Summary Report. The frequency

statistics may be requested in the form of punched output with proper values on the SELOUT card.

3.2.1.24.8 Tracking Data Validation Plot File Generation

The Tracking Data Validation plot file can be generated to FT62 through use of the SELOUT keyword card columns 15 through 17 MN (right adjusted) with N = 7. It will be generated for the first and last DC iterations, for the first DC Program iteration only, or for the last DC Program iteration only, depending on whether the user input in column 9 of that keyword card is 0, 1, or 2, respectively.

3.2.1.25 Spacecraft Attitude

The ability to handle landmark observations (by infrared camera or other detector) is included in the DC Program. Necessary parameters for the spacecraft configuration, attitude, and spin are input by the PICBIAS and LNDPAR keyword cards. Spacecraft attitude parameters may also be input by the OASENSOR keyword card as well as the true-Earth horizon crossing option.

3.2.2 SST (MULTIPLE SATELLITE) MODES

The advent of the TDRSS era has imposed a unique set of requirements on GTDS for processing TDRSS tracking data, generating mulitple satellite ephemerides, and solving for the state of up to four different satellites simultaneously. A detailed description of the mathematical formulations used in the TDRSS data processing can be found in Reference 13. An overview of the TDRSS implementation, including original requirements, analysis, and design, can be found in Reference 14.

Some of the design features of the TDRSS DC Program capability were based on the GTDS SST/Applications Technology Satellite Relay (ATSR) processing capability, although the

TDRSS processing is separate from the SST processing. It is anticipated that, since the SST capability (one target and one relay) is just a subset of the TDRSS processing capability, much of the SST ORBIT File generation, Observation Working File creation, and overall DC Program processing logic can eventually be removed from GTDS, and the TDRSS logic can be used instead.

The DC Program options available for the processing of non-TDRSS data as discussed in Section 3.2.1 are available for TDRSS DC Program runs. To process TDRSS data, however, the use of TDRSS unique keyword cards is required. There are restrictions on the available orbit generators and the type of relay satellite solve-for parameters that can be used. These restrictions will be explained in the following sections where appropriate. Some DC Program options are available for the user (target) spacecraft only, since a TDRS relay is treated as if it were just another tracking station when the GTDS DC Program is only solving for the state and/or dynamic parameters of the target satellite.

3.2.2.1 <u>DC Required Keywords</u>

The keywords required for a TDRSS DC Program run are as follows.

- CONTROL--Initiates the DC Program run
- ELEMENT1[1]--Sets coordinate system, reference central body, and first three components of state for the target satellite
- ELEMENT2[1]--Sets the second three components of state for the target satellite

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[1]These keyword cards may be omitted if epoch and elements are obtained from sources other than card input (see Sections 3.2.1.3 and 3.2.2.3).

- EPOCH[1]--Specifies the epoch of the initial state for the target satellite
- OBSINPUT--Specifies the observation input sources and acceptable times
- ORBTYPE--Sets the orbit generator type and related parameters for the target satellite
- TDROPT--Identifies the subdeck as the TDRSS processing subdeck
- END--Indicates the end of the TDROPT subdeck input
- FIN--Indicates the end of DC Program input

The first card in the DC Program input deck must be the CONTROL card, which is used to initiate the DC Program. The mandatory keyword cards ELEMENT1, ELEMENT2, EPOCH, OBSINPUT, and ORBTYPE must follow the CONTROL card.

The TDROPT subdeck turns on the TDRSS processing mode. The TDROPT subdeck must be the first subdeck in the card deck. If any data management functions are required, the TDROPT subdeck keyword cards must be followed by the DMOPT subdeck keyword, optional data management keywords, and the delimiter keyword END (see Section 3.2.2.1). If required, the subdeck keywords DCOPT and OGOPT with the proper optional keywords and END delimiters may then follow. These latter two subdecks may be in any order. The final card must be the keyword FIN, which indicates the end of the deck. This program input deck can be followed by another program input deck or decks that cause sequential runs of the other GTDS programs.

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[1]These keyword cards may be omitted if epoch and elements are obtained from sources other than card input (see Sections 3.2.1.3 and 3.2.2.3).

A detailed description of all keywords is presented in Section 4 of this document.

3.2.2.2 DC Optional Keywords

Section 3.2.1.2 lists all the optional keywords, except for the TDROPT subdeck, that may be included in a TDRSS DC Program run.

The optional keyword cards in the TDROPT subdeck are as follows.

- TDROPT--Identifies the subdeck type as the TDRSS Subdeck
- Specification of relay satellite identification numbers
  - TDRID--Sets the TDRS identifier and 7-digit international designator (This card must be the first card in the TDROPT subdeck.)
- Generation of SORs
  - TDRBATCH--Sets the batching criterion overrides for TDRSS data in the SOR
- Change a priori covariance matrixes
  - TDRCOV1--Sets the upper triangle of the a priori state covariance matrix for the relay defined in position 1
  - TDRCOV2--Sets the upper triangle of the a priori state covariance matrix for the relay defined in position 2
  - TDRCOV3--Sets the upper triangle of the a priori state covariance matrix for the relay defined in position 3

- Specification of relay initial state components and epoch
  - TDRELEM1--Sets the coordinate system of input, reference system and first three components of state for a relay satellite
  - TDRELEM2--Sets the second three components of state for a relay satellite
  - TDREPOCH--Sets the epoch of the initial state for a relay satellite
  - TDRWKELS--Specifies the retrieval of state components from various GTDS files
- Specification of output files
  - TDRFILES--Sets the level and start and end times of output ORBIT Files for the relays
- Specification of the order and degree of the geopotential
  - TDRMODEQ--Sets the maximum order and degree to be used in evaluating the geopotential when computing the equations of motion of a relay satellite
  - TDRMODVE--Sets the maximum order and degree to be used in evaluating the geopotential when computing the variational equations of a relay satellite
- Specification of options for the observations working file
  - TDROBSIN--Sets the TDRSS observation data input acceptance criteria

- Specification of orbit generator options
  - TDRORB--Sets the orbit generator type for a relay satellite
  - TDRSTEP--Sets the integration stepsize for a relay satellite
- Specification of dynamic solve-for parameters
  - TDRREFLC--Sets the solar reflectivity parameter and options for a relay satellite
  - TDRSTPAR--Sets the state solve-for parameters options for a relay satellite
- Specification of relay satellite parameters
  - TDRSCPRM--Sets the spacecraft mass, diameter, and average cross-sectional area for a relay satellite
- Specification of transponder delays
  - TDRXPNDR--Specifies satellite transponder delays for a relay satellite

3.2.2.3 Initial Elements and Epoch

The appropriate elements for the user satellite and up to three relay satellites per DC Program run can be retrieved from the following sources:

1. GTDS keyword card input (through the use of ELEMENT1, ELEMENT2, TDRELEM1, TDRELEM2, SSELEM1, and SSELEM2 keywords)
2. GTDS Permanent Elements File (TDRWKELS keyword)
3. 24-Hour Hold Elements File (TDRWKELS keyword)
4. Graphics input sources
5. GTDS ORBIT Files
6. Code 500 EPHEM Files (O-C run only)

The a priori elements for all relay satellites may be retrieved from a pregenerated ORBIT File or a PTOF through the use of the TDRWKELS keyword and by supplying the desired epoch and an ORBIT File for the desired satellites. This allows the GTDS user to process TDRSS tracking data without having to know and supply a priori elements for the TDRS relays. Online ORBIT Files are maintained for all TDRS relays and can be used for element retrieval or as the reference orbit for a relay during TDRSS observation modeling (see the TDRORB keyword in Section 4).

3.2.2.4 Observation Sources

The DATAMGT Program controls the creation of the Observation Working File as in non-TDRSS runs. TDRSS tracking data can be retrieved from either a tape or disk data set which has been created using the standard GSFC 60-byte tracking data formats. Tracking data can also be retrieved from the 60-byte Observations Data Base. There is no restriction on mixing TDRSS tracking data with ground-station tracking data in a DC Program Observations Working File. However, it is not now possible to use multiple sources of tracking data input to retrieve TDRSS tracking data except for the case in which one of the sources is a 60-byte partial batch file. All tracking data to be included in a TDRSS DC Program run, whether it is ground-based tracking of the user satellite or the relays, or relay tracking of a user (satellite-to-satellite), must be retrieved from only the 60-byte sources (see the OBSINPUT keyword). It is not possible at present to save a previously created Observation Working File via the SAVE keyword and use it as observation data input to another TDRSS DC Program execution.

To provide for efficient processing of observation data during a TDRSS DC Program run, the Observation Working File will contain several distinct sets of time ordered observation

data. The type of data to be included can be controlled by the OBSINPUT and TDRBATCH keywords. If direct ground station tracking of the target (user) satellite is to be processed during the DC Program, the observation input sources will be searched first for this type of data, which will be retrieved and stored as the first set of data on the observation working file. Next, the direct ground station tracking of the relay satellites will be retrieved and stored in separate sets on the Observation Working File, one set for each relay satellite for which observations are to be processed. Finally, the input observation sources will be searched for all measurements that must use the TDRSS ob- servation modeling routines (satellite-to-satellite and relay tracking of ground transponders) and the observations will be retrieved and placed in a time-ordered set on the Observation Working File. This results in up to five distinct sets of observation data on the Observation Working File.

The separate sets of data allow for efficient retrieval of satellite position and velocity from the ORBIT Files during observation modeling. This also means that the observation modeling routines for direct tracking data can be called into main memory and remain there during the processing of the direct tracking data for the user satellite and all of the relays. When the processing of direct tracking data is completed, the observation modeling routines can be replaced with the TDRSS modeling routines and the TDRSS data can be processed. This eliminates costly overlay segment loading and unloading. Separate sets of data also facilitate the creation of SOR batches in an efficient manner.

The time ordering of observation data on the working file is not critical in the TDRSS processing mode, since ORBIT File retrieval is used during observation modeling, but it is essential if the most efficient way of processing data is desired.

The DATAMGT Program will process the measurements related to TDRSS spacecraft orientation angles. These angles are treated as any other measurement by the Generalized Data Handler (GDH) and are output to the 60-byte tape or data base as a measurement. However, the angles are not treated as distinct measurements to be modeled in GTDS, but rather as information to be used to correct TDRSS relay range and Doppler measurements. To save space on the Observation Working File, the orientation angles (three components) are not included as individual records; instead, they are included as part of the individual record of their associated range and Doppler measurements.

3.2.2.5 ORBIT File Generation and Retrieval

In a TDRSS DC Program run, all satellite trajectories are retrieved from DAIO generated ORBIT Files. The files for the TDRS relays can be generated prior to a DC Program run and stored online for retrieval by all GTDS users. This allows users who are interested only in solving for the target satellite state and/or other dynamic parameters to treat the TDRS relays as any other tracking station, and it alleviates the need to generate TDRS reference trajectories in every DC Program run. Alternately, temporary ORBIT Files for all satellites in a DC Program run can be generated within the DC Program. The creation and use of ORBIT Files is controlled by the ORBTYPE and TDRORB keywords where the ORBTYPE card is used for the target satellite (if any) and the TDRORB keyword for the relay satellites. An ORBIT File must be generated for the target satellite if it is included in the DC Program run. It is possible to not have a target satellite in the run if only direct tracking data of the relays and relay tracking of ground transponders are included.

The temporary ORBIT Files created for all satellites can be created in two modes: with partial derivatives and without partial derivatives. If a TDRS relay state vector and/or dynamic parameters are being solved for in the DC Program run, the file must be created with the associated partial derivatives. This precludes the use of the online permanent ORBIT Files stored for each TDRS whenever the TDRS is solved for, since the permanent online files do not contain partial derivatives. The GTDS user can, on option, create an ORBIT File in the DC Program run for each TDRS that is not being solved for without partial derivatives.

The use of ORBIT Files allows for the use of unique epochs for each of the satellites included in a TDRSS DC Program run without causing a major impact. All the files maintain the unique satellite dependent information, but all are created in a DC Program run using the reference system of integration (mean 1950.0 or true-of-reference) that was chosen for the target satellite on the ORBTYPE keyword, or in the absence of a target satellite, the first relay specified. A detailed description of the choice of integration reference systems and its effect on orbit computation and observation modeling is found in Reference 13.

During DC Program observation processing, a single data record from up to four different ORBIT Files can be retrieved and stored simultaneously. This reduces the problem of record accesses for each ORBIT File, as a single record is usually sufficient for processing many tracking data points. The use of ORBIT Files does impose a restriction on the type of orbit theory used in a DC Program run. Currently, only the high-precision Cowell and time-regularized Cowell orbit theories can create ORBIT Files. However, it is anticipated that all GTDS orbit theories will be made available for use with the target satellite in the future.

3.2.2.6 Flight Sectioning

The multiple flight sectioning capability is restricted to be used for the target satellite only in TDRSS DC Program runs. (See Section 3.2.1.6 for DC Program restrictions.)

3.2.2.7 Modified DC Program (Marquardt Algorithm)

The Marquardt algorithm is available for TDRSS DC Program runs (see Section 3.2.1.7).

3.2.2.8 Solve-For Parameters

The TDRSS DC Program processing capability provides for the complete set of regular DC Program solve-for parameters via the pertinent keywords discussed in Section 3.2.1.8 plus the ability to simultaneously solve for the state vector and/or dynamic parameters for up to three TDRS relays. The dynamic solve-for parameters available are as follows:

- Target spacecraft state at target epoch
- Relay spacecraft states at relay epochs (via the TDRSTPAR keyword)
- Aerodynamic force parameter (drag) on the target satellite
- Solar radiation pressure on the target satellite
- Solar radiation pressure on the relays (via the TDRREFLC keyword)
- Gravitational harmonic coefficients
- Thrust model parameters for the target satellite
- Attitude model parameters for the target satellite

The static or local solve-for parameters are as follows:

- Tracking station locations
- Observation biases

- Ground or satellite transponder delays via the Station 5 and TDRXPNDR keywords, respectively

General restrictions on the use of the solve-for parameters are

- A maximum of 20 dynamic parameters can be estimated for each satellite (if available).
- A maximum of 50 total (dynamic plus static) can be estimated in a TDRSS DC Program run.

3.2.2.9 Consider Parameters

Consider parameter processing is not currently available in TDRSS DC Program processing.

3.2.2.10 Covariance Matrix

Currently, because of DC Program estimation software design constraints, only the diagonal elements of the relay satellite a priori covariance matrixes can be used in the DC Program covariance matrix via the TDRCOV1, TDRCOV2, and TDRCOV3 keywords.

3.2.2.11 Variational Equations for State Parameters

Analytic state partial derivatives computation is available on TDRSS DC Program runs. If this option is chosen, it will apply for all satellites in the run for which state partial derivatives are computed (see Section 3.2.1.11).

3.2.2.12 Tracking Stations and Ellipsoid Models

All options as specified in Section 3.2.1.12 are available for TDRSS DC Program runs.

3.2.2.13 Observation Weighting

All TDRSS observation measurement types have been assigned weighting factors. The full capabilities of the DC Program observation residual weighting and weight factor overrides

are available to the TDRSS DC Program processing. There are two sets of observation data weights available in GTDS. One set is used whenever an SOR is generated. The other set is used whenever the SOR is not requested. For many non-TDRSS measurement types, the weights are not identical in both sets. However, for TDRSS observations, the SOR and non-SOR data weights are identical. (For applicable observation types and data weights, see Tables A-2 and A-4.)

3.2.2.14 Observation Data Editing

3.2.2.14.1 DATAMGT Editing

The DATAMGT processing of TDRSS data supports the full observation data editing capability. TDRSS observations can be accepted or deleted via the Aƀƀƀ**** and Dƀƀƀ**** keywords in the DMOPT subdeck, according to the following criteria:

- Vehicle identification code (VIC) or satellite object number
- Forward link ID
- Return link ID
- Frequency of observations
- Ground transponder ID
- Observation type number
- Equipment mode
- Data rate indicator
- Timespan
- Receive station ID

The Observation Working File generation routines also determine the start and end times of the integration arcs used

for each satellite included in the run. The ORBIT File created for each satellite will cover only the span of data that is included in the run for that satellite; thus, unnecessary ORBIT File processing is avoided. The span of the ORBIT File is extended at each end by some small time interval (usually 1 minute) to provide a sufficient file span for observation modeling and correction computations.

3.2.2.14.2 Editing of Residuals

An observation already in the observations working file can be optionally included or deleted from the differential correction computations via the Abbb**** and Dbbb**** keywords on the DCOPT subdeck according to the following criteria:

- Observation number
- Observation time
- Observation type
- Tracker type [i.e., unified S-band (USB), GRARR, C-band, TDRSS]
- Tracking station
- Satellite ID (both target and relay IDs)
- Tracking mode (direct track, TDRS relay tracking, or a combination of both)
- TDRS measurement identifiers:
    - Return-link ID
    - Forward-link ID
    - Ground transponder ID (if a ground transponder is tracked)
    - Equipment mode (selection based on S-band or K-band operation)

- Data rate (every nth observation)
- Invalid data (validity flag on data is set on)

3.2.2.15 Dynamic Mathematical Editing

All options as specifed in Section 3.2.1.15 are available for TDRSS DC Program runs including:

- Deviation (e.g., 3-sigma edit)
- Geometry (line-of-sight)
  - Elevation angle
  - Atmospheric obscuring

TDRSS and SST data can be edited if it is determined that the signal path traverses too much of the atmosphere. This will be the case whenever the minimum ray path height, the height of the signal path above the Earth's surface, falls below a specified minimum value. For TDRSS data, atmospheric editing will also occur when the center angle, the angle formed by the signal paths between the user satellite and the two relays, exceeds a specified minimum value. Atmospheric editing is not applied to TDRSS or SST ground transponder data. The default values of the minimum ray path height and maximum center angle can be modified using the ATMOSEDT card in the DCOPT subdeck. This card can also be used to request that no atmospheric editing be performed.

3.2.2.16 Tracking Data Observation Corrections

TDRSS observations can be corrected for the following errors:

- Tropospheric/ionospheric refraction
- Transponder delay
- Timing biases
- Range ambiguities
- Station antenna mount and pointing angle error
- User spacecraft antenna offset

Transponder delay corrections to TDRSS observations are invoked with the TDRXPNDR keyword card in the TDROPT subdeck. (See Table A-3 for applicable corrections and observation types.)

3.2.2.17 Convergence Criteria

All options as specified in Section 3.2.1.17 are available in TDRSS DC Program runs.

3.2.2.18 Static Biases for Tracking Data or Transponder Delays

All TDRSS observation measurement types can have station-dependent biases applied, as described in Section 3.2.1.18. Transponder delays for ground transponders can also be applied via Station Card 5 (/*******5). (See the keyword description for Station Card 5 in Section 4.)

3.2.2.19 Output Reports

3.2.2.19.1 DC Program Initial Conditions Reports

TDRSS DC Program processing has maintained the use of GTDS DC Program Initial Conditions Reports to avoid development of redundant capabilities. However, many of the Initial Conditions Reports have been modified to function in a loop and to generate a report for the target satellite and each of the relays included in the DC Program run; consequently, the reports can be repeated up to four times. The following Initial Conditions Reports will be generated for each satellite in a DC Program run:

- Satellite ID and Configuration
- Orbit Generator Options
- Trajectory Initial Conditions
- Initial Elements
- Integration Information

The following reports show clearly labeled TDRS relay information:

- Output Data Sets Report
- Solve Parameters Reports

3.2.2.19.2 DC Program Observation Residuals Reports

Whenever TDRSS tracking data are processed in a DC Program run, an enhanced DC Program Observation Residuals Report will be generated. The name of the satellite that is being tracked is displayed with each observation. Also, if the observation involves relay satellites, a unique TDRS identifier is displayed for the forward (uplink) relay and the return (downlink) relay. If the observation type is a differenced Doppler measurement, an indication of the reference and the comparison links is provided. If the data type is relay tracking of a ground transponder (bilateration), the station acronym of the transponder is displayed for each pertinent observation.

3.2.2.19.3 End-of-DC-Program Reports

The final DC Program reports have been modified to include pertinent TDRSS relay information. Appendix H contains examples of the end-of-DC-Program reports.

3.2.2.20 Data Base Retrieval

All options as specified in Section 3.2.1.20 are available for TDRSS DC Program runs. Users should note that models or other data retrieved from GTDS permanent files will be applied to all satellites in the DC Program run (except for the use of the WORKELS keyword).

3.2.2.21 SLP Ephemeris File

All options as specified in Section 3.2.1.21 are available for TDRSS DC Program runs. Users should note that all satellites included in a TDRSS DC Program run will use the same

SLP File as required for the target satellite for the computation of planetary ephemerides and rotation and transformation matrixes.

3.2.2.22 Saving Elements and Observations Files

At the end of a DC Program run, elements for the target and relay satellites can be saved in the 24-Hour Hold Elements File or in the GTDS Permanent Elements File. (Section 3.2.1.22 contains specific details for saving target satellite elements.) The TDRWKELS card is used to save TDRS relay elements at the end of a DC run.

Currently the Observations Working File cannot be saved on tape, via the SAVE keyword, and used in a subsequent GTDS DC Program run as an observation input source.

3.2.2.23 ORBIT, ORB1, and EPHEM Files

At present, only ORBIT Files can be generated for output for the TDRS relays at the end of a DC Program run via the TDRFILES keyword. Output options for the target satellite are the same as those described in Section 3.2.1.23.

3.2.2.24 Applications Technology Satellite Satellite-to-Satellite Tracking

The GTDS DC Program was originally designed to handle a single satellite; the implementation of the ATS SST (involving two satellites) necessitated extensive program changes and has impacted the input requirements. The ATS SST processing was implemented prior to the TDRSS processing capabilities and is not as flexible as the TDRSS capabilities.

Since SST data are a mixture of relay tracking data and direct tracking data for two satellites, it is necessary to use Option 2 on the OBSINPUT card so that the input observations are sorted and separated into the proper sets. The

observation data source must be 60-byte input, either from sequential or data base files. The data management processing does not support multiple input sources for SST data. However, for SST processing, the GTDS Observation Working File may have three sets of tracking data, all input from a single 60-byte input source: direct track telemetry data on the target satellite, direct track telemetry data on the relay satellite (ATS-6), and relay track data. The set of relay track data may include data through the relay satellite to the target satellite or to various ground-transponder stations.

The required input keywords (as well as optional keywords) are shown in Table 3-1. The relay satellite keywords are input in the DCOPT subdeck.

In addition, distinct force model options may be applied to the satellites by inputting target and relay satellite information through flight section 1 and flight section 2, respectively, on keywords that allow multiple section input. Also ORBIT Files are generated and used in processing; thus, it is necessary to supply the correct JCL overrides (FRN 80 for the target and 97 for the relay satellite). The DC state solve-for parameters are available for the target and relay satellites. The relay satellite state will be solved for if indicated on the SSELEM1 keyword. Also, partial derivatives with respect to drag will only be calculated for the target satellite; likewise, those with respect to solar radiation pressure will only be calculated for the relay satellite (i.e., drag can be solved for the target satellite only and solar can be solved for the relay satellite only).

When the relay data involve solely a relay satellite and transponder stations (i.e., there are no data involving two

Table 3-1. SST Keywords

Parameter	Keyword: Relay Satellite	Keyword: Target Satellite
Initial Conditions	SSELEM1 SSELEM2	ELEMENT1 ELEMENT2
Epoch	SSEPOCH	EPOCH
Orbit Generator	SSOPT	ORBTPYE
Spacecraft Parameters	SSOPT	SCPARAM
Convariance Matrix	SSCOVAR	COVARNC

satellites in the entire DC Program run), the initial conditions for the relay satellite must be input on the DC Program mandatory keywords and on the SST optional keywords. To specify more information about transponder stations, use the Station Cards (transponder's are station type 9).

SST data processing cannot be performed in a DC Program functioning in the TDRSS data processing mode.

3.2.2.25 Nominal Ephemeris Option - Maneuver Support and Residuals Computation

A nominal maneuver trajectory is output by the non-TCOPS program GMAN prior to the start of the maneuver. This trajectory (EPHEM File) is in standard Code 500 EPHEM File format. GTDS can use this nominal ephemeris, rather than integrating from a state vector, when computing observation residuals. This requires only a single iteration of a differential correction.

Residuals can be computed using a nominal trajectory for the burn provided in standard Code 500 EPHEM file format by the GMAN. GTDS can read an EPHEM file and use the retrieved vectors to compute observations to be used in the calculation of residuals. This is done by accessing an EPHEM file retrieval routine as an option at the point in

the system where the orbit generator is called. ORBTYPE 14 is used to trigger this process.

Two restrictions must be observed when using GTDS for maneuver support: the computation of residuals using an EPHEM file can be performed only in a GTDS O-C run (i.e., a single iteration of a DC run), and the 5080. There are no other restrictions placed on GTDS residual processing as a result of these modifications. The GTDS residual computations can be run in any mode available to GTDS through the graphics interface GTDS, as a batch job, or in GSP graphics mode. Additionally, automatic residual processing is available through the graphics interface.

3.3 FILTER PROGRAM

The Filter (FILTER) Program is no longer maintained in GTDS because of current operational requirements and load module overlay constraints.

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3.4 EARLY ORBIT DETERMINATION (EARLYORB) PROGRAM

The estimator algorithm in GTDS requires an a priori estimate of the spacecraft position and velocity to initiate the iterative estimation process (see Section 3.2 and Reference 2). A reasonable estimate is frequently unobtainable because of large booster injection errors, maneuver errors, or unknown orbits of tracked satellites. The EARLYORB Program provides the capability to determine these starting values of position and velocity from a limited number of discrete tracking observations.

The three methods by which the two-body starting vector may be computed are the Gauss Method, the Double-r Iteration Method, and the Range and Angles Method. By having three methods instead of one, the GTDS EARLYORB Program provides greater flexibility for handling data types and time distributions of observations. In general, the only input required is the designation of the EARLYORB method and the observations to be used in the computation. Each method, along with its particular input requirements, is discussed in Sections 3.4.3 through 3.4.5.

The EARLYORB Program may be invoked directly within a Differential Correction run by supplying a WORKELS card, with the Early Orbit option, in place of the EPOCH and ELEMENT cards. The EARLYORB Program will automatically select the epoch and elements and supply them to the DC. (It should be noted that the DSN Mark IVA angle data cannot be used at this time for early orbit determination because of some existing problems, such as a lack of autotracking capability.)

It should be noted that the OUTPUT option (invoked on the CONTROL card) can be used to pass the orbital elements from an EARLYORB run to a DC or an EPHEM. Alternatively, the elements can be written to the TCOPS Vector Hold File (TVHF) and read by the EARLYORB Program.

Details of this are given in the GUI User's Guide. Alternatively, two separate batch runs can be submitted.

3.4.1 EARLY ORBIT DETERMINATION REQUIRED KEYWORDS

The following keywords are required for an EARLYORB Program run.

- CONTROL--Initiates the EARLYORB Program run
- EOINTRVL--Sets the minimum time difference between observations*
- EPOCH--Specifies epoch data
- OBSINPUT--Specifies the source of the observation input
- OBSNUME**--Specifies observations types and times
- TYPE--Specifies the early orbit determination method and provides initial estimates of geocentric distance, semimajor axis, and orbital motion direction
- FIN--Specifies the end of the EARLYORB Program input deck

The first card in the EARLYORB Program input deck must be the CONTROL card that initiates the EARLYORB Program. This must be followed by the mandatory cards EPOCH, OBSINPUT, OBSNUME, and TYPE. More than one OBSNUME card can be included. If a modified station geodetics working file is

*If this keyword card is omitted, the minimum time interval will default to 30 seconds.

**This keyword is necessary only for selecting the individual observations from an input data source to be used by the Early Orbit program.

required, the DMOPT subdeck should immediately follow the mandatory cards. A DMOPT subdeck need not be included if the observation source is input via cards. The DCOPT and OGOPT subdecks should then be included as needed (see Sections 3.4.2.2 and 3.4.2.3). The final keyword card must be the FIN card that indicates the end of the input deck. This EARLYORB input deck may be followed by other input decks that execute any of the GTDS programs. (Section 4 contains detailed descriptions of all keyword formats.)

3.4.2 EARLY ORBIT DETERMINATION OPTIONAL KEYWORDS

This section lists all the optional keywords that may be included in an EARLYORB Program run. (See Sections 3.1 and 3.2 for detailed descriptions of their use.)

3.4.2.1 Optional Data Management Keywords (DMOPT Subdeck)

The optional keyword cards in the DMOPT subdeck are as follows:

- DMOPT--Identifies the subdeck type as the Data Management Subdeck
- RTSATID--Specifies all satellite IDs for which partial batch data are to be requested
- RTPARAMS--Specifies the partial batch request parameters
- RSTA****--Specifies the tracking station for which partial batch data are to be requested
- RSYS****--Specifies the tracking system for which partial batch data are to be requested
- WORKGEO--Builds a working station geodetics file

3.4.2.2 Optional Orbit Generator Keywords (OGOPT Subdeck)

The optional keyword cards in the OGOPT subdeck are as follows:

- OGOPT--Identifies the subdeck type as the Orbit Generator Subdeck
- CNM--Sets $C_{n,m}$ harmonic coefficients
- SNM--Sets $S_{n,m}$ harmonic coefficients
- HARMONIC--Sets entire harmonic field

3.4.2.3 Optional DC Keywords (DCOPT Subdeck)

The optional keyword cards in the DCOPT subdeck are as follows:

- DCOPT--Identifies the subdeck type as the DC Subdeck
- /*******1--Station Card 1 - Defines station type and position
- /*******2--Station Card 2 - Defines station-dependent data

3.4.2.4 Optional Early Orbit Keywords (EOOPT Subdeck)

The optional keyword cards in the EOOPT subdeck are as follows:

- EOOPT--Identifies the Early Orbit subdeck
- PRESEARCH--Used to activate the preliminary orbit search (used only by the Double-r method) and set related control parameters
- EODOUBLR--Used to set control parameters for the Double-r method

3.4.3 DOUBLE-r ITERATION METHOD

The Double-r Iteration Method requires three observation pairs, where each pair is a set of two simultaneous angle

measurements. The acceptable observation pairs are as follows:

- GRARR X_{30} and Y_{30} gimbal angles
- USB X_{85} and Y_{85} gimbal angles
- C-band azimuth and elevation angles (A, E)
- Smithsonian topocentric right ascension and declination angles (α, δ)
- Minitrack direction cosines (ℓ, m)

Limitations on the observation pairs are as follows:

- Because the Double-r method accounts only for two-body motion, accuracy will deteriorate when using observations made over multiple orbits. Furthermore, observations that are close to an integer multiple of 180 degrees in true anomaly apart will be unlikely to produce a convergent solution. For example, if the orbital period is 88 minutes, a pair of observations 89 minutes apart may cause the method to fail.
- The components of the observation pair must be within 2 seconds in time of each other.
- Observation pairs must be no closer than 2 degrees in true anomaly to each other.

Two additional input requirements for the Double-r iteration method are initial estimates of the geocentric distances of the first and second observation pairs and the direction of orbital motion. These estimates can be provided in two ways. The first method is to enter the estimates on the TYPE keyword card. Alternatively, the preliminary orbit search may be used.

The preliminary orbit search estimates the two geocentric distances for the first two observation pairs given an

estimate of the spacecraft's height at the time of the second observation. This method is invoked by providing a PRESEARCH keyword card in an EOOPT subdeck.

In either case, an iterative process is performed on the geocentric distance estimates until either convergence or a limit of 35 iterations is reached. The orbital motion direction estimate is either direct (for orbit inclinations between 0 and 90 degrees) or retrograde (for orbit inclinations between 90 and 180 degrees). Alternatively, the software will determine the inclination by leaving blank the pertinent field on the TYPE keyword card.

Care must be taken when the orbital direction is determined by software. The direction determination logic is dependent on the time differences between the observations. Consequently, the software will determine the direction only if one of the following sets of conditions holds:

- The time between the first and second observations is less than 84 minutes, and the time between the second and third observations is greater than the time between the first and second observations.
- The time between the second and third observations is greater than 84 minutes, and the time between the first and second observations is greater than the time between the second and third observations.

The EODOUBLR keycard can be used to set the desired accuracy and control the rate of convergence for a Double-r method run. Additionally, this card allows the user to specify the number of orbital revolutions between observations when the observations are selected via OBSNUME cards. It should be noted that the EODOUBLR card has no effect on the automatic selection of observations; it simply informs the software how to proceed with the observations that have been selected.

3.4.4 GAUSS METHOD

Observation requirements for the Gauss Method are the same as those for the Double-r Iteration Method, with one additional limitation on the angle pairs. If the observations lie in an arc of more than 60 degrees in true anomaly, the method could diverge (see Reference 2). Therefore, the angle pairs must be in an arc of no more than 60 degrees in true anomaly.

Estimates for the geocentric distances and orbital motion direction are not required for the Gauss Method. Instead, an estimate of the semimajor axis (in kilometers) must be provided on the TYPE keyword card. The maximum number of internal iterations for the Gauss Method is 60, with termination of the early orbit determination process when the range residuals grow from one iteration to the next.

3.4.5 RANGE AND ANGLES METHOD

The Range and Angles Method is considerably different from the first two methods. It accepts observation triplets as input. Each triplet consists of three simultaneous component observations, one range and two angles. The method will accept from 2 to 16 triplets (i.e., from 6 to 48 actual observations) of the following types:

- GRARR range, X_{30}, Y_{30}
- USB range, X_{85}, Y_{85}
- Range, azimuth, elevation
- Geocentric inertial X_i, Y_i, Z_i coordinates
- Range and minitrack ℓ and m direction cosines

The individual observations within the triplet must be within 2 seconds in time of each other for near-Earth satellites. For distant geosynchronous satellites, larger time differences are allowable. The triplets may also be from up

to 10 different tracking stations; however, as with the Gauss Method, if the triplets lie in an arc greater than 60 degrees in true anomaly, divergence may occur (see Reference 2). Care must also be taken to ensure that the range observations are the correct measurements and not gated values. The only other input required is an initial estimate of the semimajor axis in kilometers.

The Range and Angles Method will terminate upon convergence, on a maximum of 20 iterations on the outer loop (with 10 iterations of each of two internal loops), or on computation of a singular matrix. There is one limitation peculiar to the Range and Angles Method: a circular orbit is internally assumed on initial iterations, and problems may arise for satellite orbits with high eccentricities.

3.4.6 SELECTION OF THE EARLY ORBIT DETERMINATION METHOD AND EPOCH

The user can allow the EARLYORB Program to interogate the input data and select the best method for that data via the Automatic Method. This method will first determine if there are range measurements in the input data. If so, the Range and Angles method will be used. If there are no range measurements, the Gauss Method will be attempted and if that fails the program will switch to the Double-r Method. Since results will deteriorate if the input epoch is far in time from the data, the Automatic method will select observations as close to the epoch as possible.

Based on previous results of the EARLYORB Program, the following order of method selection is suggested.

- Automatic method should be chosen whenever possible. It will choose, according to the contents of the observation input file, the most appropriate of the three Early Orbit Methods.

- Where at least two triplets are available, the Range and Angles Method should be used. If divergence occurs because of the true anomaly arc-length being exceeded or the eccentricity being too high, try the Gauss Method.

- If no range measurements are available or if the Range and Angles Method fails, use the Gauss Method over a selected arc of 60 degrees or less in true anomaly. If that fails or if the observations are spread over an arc of more than 60 degrees in true anomaly, try the Double-r Iteration Method.

- The Double-r Iteration Method only should be used when the true anomaly arc is greater than 60 degrees.

Once the method to be used has been selected, it is indicated with the TYPE keyword card. This keyword card also allows for the initial estimates of geocentric cistances and orbital motion direction for the Double-r Method. The epoch date desired is input via the EPOCH keyword card. If the epoch is input as zero, EARLYORB will supply the starting vector at the time of the second observation. A zero epoch should be specified whenever possible, to optimize the EARLYORB results. If the epoch is specified, the vector at the second observation time will be updated using J_2 effects.

3.4.7 SELECTION OF OBSERVATIONS

Unless the user has selected individual observations to be used via the use of the OBSNUME keyword card, the EARLYORB Program will batch the input observations and order the batches as best to fit the users requirements input via the EPOCH, TYPE and EOINTRVL keyword cards. Since results will

deteriorate the farther the epoch is from the observations used, if a non-zero epoch is specified, the program will select observation as close to that epoch as the data will allow. If the user has specified the Automatic Method, and range measurements are available, the Range and Angles method will be attempted first. The selected observation, triplets or doublets will be separated by the time interval specified on the EIONTRVL card. No triplet or doublet whose elevation anagle is less than the minimum specified on the EOINTRVL card will be included.

If the user has opted to use the OBSNUME keyword card and selectes the observations, the contents of the input observations file must first be known. That is, the type and time of each observation to be selected must be known. Three angle pairs (containing 6 scalar components) must be input to the Gauss Method and the Double-r Iteration Method, and up to 16 triplets of range of angles (containing up to 48 scalar components) may be input to the Range and Angles Method. The observations selected must represent acceptable triplets (i.e., all components of a pair or triplet must be within the allowable time of each other, they must all be from the same station, and they must be of the proper measurement types). The observation measurements types and times are input on the OBSNUME keyword card. The triplets themselves must be separated by the time interval specified on the EOINTRVL card.

The observations may alternatively be punched onto cards and input via DD card FT15F001 (see Section 5 for further JCL information). The format for observation card input is as follows:

Columns	1 - 8	9-11	12-14	15-17	18-38	39-59	60-80
	ssssssss	iii	jjj	kkk	time	obs1	obs2

where ssssssss = the station name
iii = the observation type indicator
jjj = the range-gating indicator
kkk = a blank field
time = the observation time in the format yymmddhhmmss.ssss
obs1 = the observation value
obs2 = the corrected observation value

Since the card input file is not rewound after being read, it is necessary to indicate the beginning and end of each set of observations with cards that say "OBSCARD" and "END" (beginning in card column 1). The observation card input follows the GO.FT15F001 DD card and appears as follows:

```
OBSCARD
ssssssss   17  1    731024212340.    1.4922565    1.4922637
    .
    .
    .
ssssssss   18  1    731024221730.    -.6283185    -.6283183
END
OBSCARD
ssssssss   17  1    731025031017.    6372.459     6372.462
    .
    .
    .
ssssssss   18  1    731025031712     -.327643     -.327639
END
```

In this example, two complete sets of observation input are provided, enabling the user to make two complete EARLYORB Program runs.

3.4.8 EARLYORB PROGRAM OUTPUT

Two output reports are provided by the EARLYORB Program. The first is a report of the observations used and the method type. The second is a report of the results of the computation. The second report includes the epoch time, converged elements in Cartesian, Keplerian, and spherical

coordinates, and the true anomaly at epoch. The output elements are Earth-centered and referenced to TOD coordinates.

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3.5 DATASIM PROGRAM

The DATASIM Program outputs a simulated observation file for a given spacecraft and set of stations. These observations are output as a function of an input tracking schedule and the stations observing the satellite.

The DATASIM Program can output tracking data (i.e., range and range-rate, and m direction cosines, elevation, azimuth, gimbal angles) or attitude sensor data (i.e., Sun angle, Earth-in elapsed time, Earth-out elapsed time, and solar occultation). For attitude sensor data, a pseudostation is used to simplify user input and program logic.

The following are the input considerations for the DATASIM Program.

- Stations that observe the satellite (Section 3.5.3)
- Station geodetics (Section 3.5.4)
- Satellite ephemeris data and output observation tape(s) (Section 3.5.5)
- Tracking schedule (Section 3.5.6)
- Biases and random errors (Section 3.5.7)
- Station errors (Section 3.5.8)
- Force model constants (Section 3.5.9)
- SLP Ephemeris File (Section 3.5.10)
- Observation corrections (Section 3.5.11)
- Output options (Section 3.5.12)
- Attitude sensor data simulation (Section 3.5.13)
- SST data simulation (Section 3.5.14)

Users of the DATASIM Program must realize that the observations are computed with the same model as the DC Program, and hence the observation tape can be used as input to the DC Program for prelaunch testing and analysis.

Sections 3.5.1 and 3.5.2 list the permissible keywords for the DATASIM Program, and the subsequent sections describe the use of those keywords that fulfill each basic DATASIM input requirement.

3.5.1 DATA SIMULATION REQUIRED KEYWORDS

The following keywords are required for a DATASIM Program run.

- CONTROL--Initiates the DATASIM Program run
- DMOPT--Identifies the subdeck type as the Data Management Subdeck
- WORKGEO--Builds Station Geodetics Working File (A list of stations must follow the WORKGEO keyword card)
- END--Specifies end of the DMOPT subdeck
- FIN--Indicates end of the DATASIM Program input deck

The first card in the DATASIM input deck must be the CONTROL card that initiates the program. Following must be a Data Management (DMOPT) Subdeck, which will create the station geodetics working file via the WORKGEO keyword card. If a working SLP Ephemeris File or a refraction table is required, the necessary keyword cards must also be included in the DMOPT deck.

An OGOPT subdeck can be input to change constants (e.g., flattening coefficient, radius, of central body, rotational rate, and attitude coefficients) and a DCOPT subdeck can be input to change the DATASIM default options. The final card must be the keyword FIN. This program input deck can be

followed by other program input decks that execute any of the GTDS programs.

In addition, an ORBIT File is required as input to the DATASIM Program to provide the satellite ephemeris data. It must have been created in a previous step (or job), usually via the EPHEM Program. The physical location of this file is described via keyword DSPEA2 and the JCL (see Section 5, DD cards 19, 20, 21, and 22). Complete descriptions for all keyword cards are presented in Section 4.

The reader is reminded that a Data Management Subdeck (DMOPT) with a WORKGEO keyword card and a list of the stations being used are required. (If other Data Management keywords are desired, they can also be inserted in the subdeck.) In the absence of any additional input, the DATASIM Program uses standard default values and options, which are as follows:

- A type 2 schedule is used, which generates a maximum of 10 passes per station and observes the satellite every minute for the first 5 minutes of each pass (see Section 3.5.6 for more detail).
- A GTDS observation tape is generated, using an input ORBIT File on unit 22 (i.e., sequential file without partial derivatives) (see Section 3.5.5.2).
- DATASIM Program start and end times default to the timespan of the ORBIT File.
- The standard observation types that can be measured by the specified station are output (e.g., a minitrack station will compute the ℓ and m direction cosine).
- Output observations include no biases, no random errors, no modeling effects, a minimum elevation angle of 0 degrees, and no station geodetic errors.

- Printer output consists of Initial Conditions Report, Observations Report, and DATASIM Summary Report.

3.5.2 DATA SIMULATION OPTIONAL KEYWORDS

This section lists all the optional keywords that may be included in a DATASIM Program run. The subsequent paragraphs list these keywords by subdecks. Detailed descriptions of the use of many of the keyword cards appear in Sections 3.1 and 3.2.

3.5.2.1 Optional Data Management Keywords (DMOPT Subdeck*)

The optional keyword cards in the DMOPT subdeck are as follows.

- DMOPT--Identifies the subdeck type as the Data Management Subdeck.
- OBSDEV--Sets observation standard deviation
- RELAYID--Specifies ATS relay satellite identification numbers
- SLPBODY--Sets central and noncentral bodies for generating the SLP Ephemeris Working File
- SLPCOORD--Sets SLP Ephemeris File coordinate system
- SLPDEG--Sets degree of curve-fit for bodies and rotation matrices
- SLPFILE--Indicates source of planetary ephemeris data to create working SLP file
- WORKIONO--Builds Ionospheric Refraction Working File
- /*******--(Station Cards 1 and/or 2) - Define station type, position, and dependent data

*This subdeck is required.

3.5.2.2 Optional Orbit Generator Keywords (OGOPT Subdeck)

The optional keyword cards in the OGOPT subdeck are as follows:

- OGOPT--Identifies the subdeck type as the Orbit Generator Subdeck
- ATTANG1--Sets polynomial coefficients for right ascension or yaw angle
- ATTANG2--Sets polynomial coefficients for declination or pitch angle
- BDROTATE--Sets body rotation rate
- BODYRAD--Sets equatorial radius for specified body
- FLATCOEF--Sets flattening coefficients for specified body
- INTEROUT--Sets intermediate output options
- TITLE--Sets run identification title

3.5.2.3 Optional DC Keywords (DCOPT) Subdeck)

The optional keyword cards in the DCOPT subdeck are as follows.

- DCOPT--Identifies the subdeck type as the DC Subdeck
- DSPEA1--Sets DATASIM Program tracking schedule data
- DSPEA2--Sets input ephemeris file and end of DATASIM timespan
- DSPEA3--Sets DATASIM output options
- ELLMODEL--Sets ellipsoid model
- INTEROUT--Sets intermediate output options
- OBSCORR--Sets observation correction parameters

- OASENSOR--Sets spin rate and mounting angle for attitude sensor data
- SSTSIM--Sets parameters used in simulation of SST data
- TRACKELV--Sets minimum allowable elevation angle for each tracking system
- TRNDLY--Sets transponder time delay table
- /*******1--Sets station type and position
- /*******2--Sets station-dependent parameters
- /*******5--Sets observation biases
- /*******6--Sets observation correction flags
- /*******7--Sets miscellaneous DATASIM schedule data
- /*******8--Sets observation types and station errors
- /*******9--Sets DATASIM tracking intervals

3.5.3 STATIONS THAT OBSERVE THE SATELLITE

The stations used in a DATASIM Program run are input through the DMOPT subdeck. In particular, the WORKGEO keyword card is immediately followed by the list of stations. Columns 13 through 14 of the WORKGEO keyword card contain the number of stations (maximum of 20). (Section 4 describes in detail the WORKGEO keyword card.) GTDS stores the station index number, station type [very high frequency (VHF), minitrack, C-band, S-band, or USB], geodetic height and latitude, east longitude, ellipsoid model number, antenna offset, north/south and east/west deflections, and transmitter frequency.

There will be occasions when this station information will be unavailable in the Tracking Stations Geodetics File or when the user wishes to modify the existing geodetic information. The procedure to be followed in these instances is

described in Section 3.5.4. Specific instructions for inputting pseudostations to generate attitude sensor data (i.e., Sun angle, Earth-in and Earth-out elapsed times, and solar occultation) are presented in Section 3.5.13.

3.5.4 STATION GEODETICS

The following paragraphs describe how to input stations that are not in the Tracking Station Geodetics File or to modify geodetic information for stations that are in the file. The sections also describe the use of a different standard ellipsoid model.

3.5.4.1 Inputting New Stations

If a station to be used in the DATASIM Program is not in the GTDS Tracking Station Geodetics File, then a Station Card 1 keyword with the following information should be included in the DMOPT subdeck: index number, station type (i.e., VHF, minitrack, C-band, S-band, USB), geodetic height and latitude, and east longitude. The Station Card 1 keyword is of the form /*******1, where ******* is the station name. The remaining data can be optionally input on a Station Card 2 keyword card or, otherwise, default values will be assigned. (See Section 4 for a description of the /*******2 card.)

3.5.4.2 Modifying Station Geodetics

If a user wishes to modify the geodetics data, Station Card 1 or Station Card 2 should be included in the DCOPT subdeck. (The data to be modified are described on the station keyword cards in Section 4.)

3.5.4.3 Ellipsoid Model

Each station is referenced to ellipsoid model 1. This ellipsoid has a semimajor axis of 6378.166 kilometers and an inverse flattening coefficient of 298.3. This model can be

modified by including in a DCOPT subdeck the ELLMODEL keyword card with the modified values.

Different stations in GTDS can reference up to five different ellipsoid models. For example, a new model may be input via an ELLMODEL keyword card and labeled model 2. The station to reference this model must then be pointed to model 2. Hence, a Station Card 2 keyword card with a 2 (the model number) in column 14 is required (see Section 4).

3.5.5 SATELLITE EPHEMERIS AND OUTPUT OBSERVATION TAPE(S)

The DATASIM Program requires two sets of data files: (1) an input ephemeris file to compute satellite position and velocity and (2) output file(s) containing the observations in GTDS observation format or DODS observation tape format. These files, as used in the DATASIM Program, are described in the following two sections.

3.5.5.1 Satellite Ephemeris Data

To calculate observations for a spacecraft, it is necessary to have the satellite's position and velocity at the observation time. The DATASIM Program satisfies this requirement by inputting a satellite's ephemeris over a given period of time as a data file and interpolating position and velocity from this data.

This file is in the ORBIT File format (i.e., acceleration data). The file also has a header that contains the satellite ID, start and end times of the ephemeris data, epoch and elements used to generate the file, and other data.

Thus, the file that is input to the DATASIM Program must have been generated prior to execution of the DATASIM Program. This can be done either in the EPHEM Program (see Section 3.1.7) or in the DC Program (see Section 3.2.1.23). The file can be generated in the same or in a different job step.

One of the following four ORBIT Files is acceptable to the DATASIM Program:

ORBIT File	Unit Number
Disk data set with partial derivatives - direct access	19
Disk data set without partial derivatives - direct access	20
Tape data set with partial derivatives - sequential	21
Tape data set without partial derivatives - sequential	22

In a DATASIM Program run, the file on unit 22 (i.e., a sequential ORBIT File of acceleration data without partial derivatives) is used by default. To change this, a DSPEA2 keyword card in a DCOPT subdeck is included with the file being used indicated in columns 10-11. In addition, if the ORBIT File is a direct access file, the level number must also be input in column 14. For example, if a user had generated level one of an ORBIT File on disk without partial derivatives in an EPHEM Program run, then to input the file into a DATASIM Program run, the user must input the following card in the DCOPT subdeck:

Columns	1 - 8	10-11	14
	DSPEA2	20	1

In all cases, the correct DD card must be used in the JCL.

3.5.5.2 Output Observation Tapes

By default, the DATASIM Program will output a GTDS observation tape. To change this option (i.e., to output a DODS observation tape or GTDS and DODS observation tapes) the user must include in a DCOPT subdeck the DSPEA1 keyword card with n in column 14, where

n = 0, output GTDS observation tape only

n = 1, output DODS and GTDS observation tapes

n = 2, output DODS observation tape only

n = 3, output General Data Handler observation tape only

For a GTDS tape, a DD card for unit 29 is required in the JCL; for a DODS tape a DD card for unit 30 is needed; and for a GDH tape, a DD card for unit 91 is needed. See Section 5 provides detailed JCL requirements.

3.5.6 TRACKING SCHEDULE

Tracking station scheduling information is required to specify any of the following:

- Type of the tracking schedule
- Start and end time of the DATASIM Program
- Satellite pass tracking frequency
- Time intervals to observe the satellite and the rate at which to compute observations
- Elevation angle constraints
- Type of observations output

The first three categories of data in the preceding list are station-independent; the remaining three are station dependent. Regardless of schedule information, observations are output only when the satellite is visible to a station (i.e., elevation angle is larger than some constraint value).

To modify any of the default schedule information, a DCOPT subdeck is required with one or more of the following keyword cards: DSPEA1, DSPEA2, OBSCORR, and the Station Cards 7, 8, and 9.

The description of the scheduling input data has been divided into two sections, station-independent data and station-dependent data.

3.5.6.1 Station-Independent Data

Station-independent scheduling data are used for all stations in the DATASIM Program run. These data specify the type of tracking schedule, general start and end times of the DATASIM Program run, and tracking frequency used to determine satellite passes.

3.5.6.1.1 Type of Tracking Schedule

In the DATASIM Program, tracking schedules can be one of the following four types:

- Type 1 - Periodic--Fixed frequency observations during specified timespans repeated periodically
- Type 2 - Satellite pass--Fixed frequency during station passes
- Type 3 - Special events--Fixed frequency during interval centered at apogee or perigee
- Type 4 - DODS observation tape--Observation times same as on an input DODS observation tape

The tracking schedule type parameter allows the user to specify different means of inputting tracking intervals. A more detailed definition of each schedule type is given in Section 3.5.6.2.

The default value for the DATASIM Program tracking schedule type is Type 2, the satellite pass. To change this type, a DSPEA1 keyword card must be input with the proper value in column 11. The same schedule type is used for all stations.

3.5.6.1.2 Start and End Times

As in other GTDS programs, general start and end times are used. These times default to the start and end times of the satellite ephemeris tape. To modify either default time, the start time must be input on the DSPEA1 keyword card and

the end time must be input on the DSPEA2 keyword card. However, to be valid, the requested timespan must be within the timespan of the ephemeris file.

3.5.6.1.3 Satellite Pass Tracking Frequency

The DATASIM Program determines the approximate start and end times of each satellite pass for any station. A general tracking frequency (TPASS) is used to calculate these times. The default value is 60.0 seconds. To modify this value, the desired frequency must be input on the DSPEA1 keyword card in columns 60 through 80.

3.5.6.1.4 Initial Revolution Number

The revolution number is used for the printer output and the DATASIM Program summary file. This number is printed on the first summary report and then updated for each subsequent revolution. The default value is zero. To change the default value, the desired revolution number is input on the DSPEA1 keyword card in columns 15 through 17.

3.5.6.2 Station-Dependent Data

Station-dependent data define the time intervals over which to observe the satellite, the observation frequency, the minimum elevation angle allowed, and the type of observations output. Table 3-2 shows the permissible data used for each tracking schedule. Because the observation intervals and observation frequency are dependent on the tracking schedule type, they are discussed in Section 3.5.6.1.

3.5.6.2.1 Periodic Tracking Schedule

A periodic tracking schedule is described as follows: given a basic set of NDELT time intervals (a maximum of 10) and a frequency, DELT, at which to compute observations within each interval, the basic set of time intervals is periodically repeated every TIMSEE hours up to IPRIOD times. Thus,

Table 3-2. Permissible Station-Dependent Parameters

PARAMETER NAME	KEYWORD CARD	BRIEF DESCRIPTION	MODE 1	MODE 2	MODE 3	MODE 4
NDELT	/•••••••7	NUMBER OF INTERVALS OR PASSES	Y	Y	Y	N
IEVENT	/•••••••7	TYPE OF EVENT	N	N	Y	N
IPRIOD	/•••••••7	NUMBER OF PERIODS	Y	N	N	N
DELT	/•••••••7	FREQUENCY RATE (SECONDS)	Y	Y	Y	N
TIMSEE	/•••••••7	PERIOD (HOURS) OR LENGTH OF INTERVAL (SECONDS)	Y	Y	Y	N
ELMIN	/•••••••7	MINIMUM ELEVATION ANGLE FOR A PASS (DEGREES)	Y	Y	Y	Y
IOBS	/•••••••8	TYPE OF OUTPUT OBSERVATION(S)	Y	Y	Y	N
I	/•••••••9	INTERVAL NUMBER	Y	Y (=1)	N	N
TIMES (1, I)	/•••••••9	START TIME OF INTERVAL I	Y	Y	N	N
TIMES (2, I)	/•••••••9	END TIME OF INTERVAL I	Y	N	N	N

NOTES: (A) ••••••• – ALPHANUMERIC NAME OF STATION

(B) MODE 1 – PERIODIC TRACKING SCHEDULE
MODE 2 – SATELLITE PASS TRACKING SCHEDULE
MODE 3 – SPECIFIC EVENTS TRACKING SCHEDULE
MODE 4 – DODS OBSERVATION TAPE SCHEDULE

(C) Y INDICATES YES, THE PARAMETER IS PERMISSIBLE.
N INDICATES NO, THE PARAMETER IS NOT PERMISSIBLE.

a few time intervals per station are required, and they can be repeated periodically with minimum input requirements.

Whenever a periodic tracking schedule is used, a Station Card 7 or a Station Card 9 can be input to the DATASIM Program. Station Card 7 contains the following:

- NDELT--number of intervals per period
- IPRIOD--number of periods
- DELT--observation frequency rate (seconds)
- TIMSEE--length of a period (hours)

In the absence of any input for these parameters, the program will use the following default values:

- NDELT = 1
- IPRIOD = 1
- DELT = TPASS (see Section 3.5.6.1.3)
- TIMSEE = 24 hours

The individual time intervals are input on Station Card 9. This card contains the interval number, j, the start time, TIMES(1,j), and the end time, TIMES(2,j).

In the absence of any input, the start time defaults to the start time of the DATASIM Program run, and the end time defaults to the end time of the DATASIM Program run. In this case, the implication is that one period is being used. The following example shows the use of this mode.

Let stations MADGA6P and FTMYR6P observe a satellite. The time frame is from midnight, October 9, 1972, to midnight, October 12, 1972. MADGA6P is to observe the satellite the first and third hours of October 10, 1972, and this is to be repeated periodically every 6 hours for 48 hours. Hence, there are two intervals per period and there are eight periods (48/6=8). During each interval the satellite will be observed every 2 minutes.

FTMYR6P is to observe the satellite from midnight of October 10, 1972, to midnight of October 12, 1972, and the observation is to be made every 4 minutes. Assuming the DSPEA1 and DSPEA2 keyword cards have been specified, the following keyword cards are also required (see Section 4):

Columns	1 - 9	11	17	18 - 38	39 - 59
	/MADGA6P9	2	8	120.0	6.0
	/MADGA6P9	1			721010010000.0
	/MADGA6P9	2		721010020000.0	721010030000.0
	/FTMYR6P7			240.0	
	/FTMRY6P9	1		721011000000.0	

The /MADGA6P7 and /FTMYR6P7 keyword cards indicate that for MADGA6P

- NDELT = 2
- IPRIOD = 8
- DELT = 120.0 seconds
- TIMSEE = 6.0 hours

and for FTMYR6P

- NDELT = 1 (by default)
- IPRIOD = 1 (by default)
- DELT = 240.0 seconds
- TIMSEE = 24 hours (by default)

Thus, MADGA6P will observe the satellite on October 10, W 1972, from $0^h - 1^h$, $2^h - 3^h$, $6^h - 7^h$, $8^h - 9^h$, $12^h - 13^h$, $14^h - 15^h$, $18^h - 19^h$, $20^h - 21^h$, and for the same time intervals on October 11, 1972.

The following should be noted for the periodic tracking schedule:

- If these two keyword cards are not input for a station, the station will observe the satellite every TPASS seconds from the start time to the end time of the DATASIM Program run (see Section 3.5.6.1.3).

- The intervals must be in increasing chronological order.
- If more than one period is used, the end time of the last interval minus the start time of the first interval must be less than the period length (TIMSEE).

3.5.6.2.2 Satellite Pass Tracking Schedule

The satellite pass tracking schedule is described as follows. A station is to observe the satellite for NDELT passes. During each pass, observations are computed at a frequency of DELT seconds for a length of TIMSEE seconds.

Whenever a satellite pass tracking schedule is used, Station Card 7 or 9 can be input to the DATASIM Program. Station Card 7 contains the following:

- NDELT--the number of passes for the station
- DELT--the observation frequency rate (seconds)
- TIMSEE--the length of time to observe the satellite in a pass (seconds)

In the absence of any input for these parameters, the DATASIM Program defaults to:

- NDELT = 10
- DELT = TPASS (i.e., the frequency to compute satellite passes (see Section 3.5.6.1.3))
- TIMSEE = 300.0 seconds

The start time for a given station can be input on Station Card 9. In this case, the interval number is set equal to 1 in card column 11, and the interval start time is input in columns 18 through 38. (In the absence of any input, the start time will default to the start time of the DATASIM Program run.)

The following example shows the use of this schedule type. Referring to the Periodic Tracking Schedule example (Section 3.5.6.2.1), let MADGA6P observe the satellite for 20 passes, observing every minute for the first 10 minutes of each pass. Let FTMYR6P observe the satellite for six passes, observing every 4 minutes for the whole pass. Then, the following cards are required:

Columns	1 - 9	10-11	18 - 38	39 - 59
	/MADGA6P7	20		600.0
	/FTMYR6P7	6	240.0	1.D+10*
	/FTMYR6P9	1	721010020000.0	

In this case, the /MADGA6P7 and /FTMYR6P7 keyword cards indicate that for MADGA6P

- NDELT = 20
- DELT = 60 seconds (by default)
- TIMSEE = 600 seconds

and for FTMYR6P

- NDELT = 6
- DELT = 240.0 seconds
- TIMSEE = 1.D + 10 seconds (which implies the entire length of the pass)

If any pass for a station extends beyond the end time of the DATASIM Program run, that station will no longer observe the satellite.

3.5.6.2.3 Special Event Tracking Schedule

The special event mode is described as follows. For a given satellite special event (IEVENT), apogee or perigee, the approximate time of the event is determined. An interval of

*An arbitrarily large number.

2.0*TIMSEE seconds is built around the event, and the satellite is observed every DELT seconds within the interval. This interval is repeated NDELT times by adding the satellite's period to the above time interval.

Whenever this mode is used, a Station Card 7 can be input to the DATASIM Program containing

- NDELT--the number of intervals
- IEVENT--the type of event (=1, apogee; =2, perigee)
- TIMSEE--the length of half an interval about the time of the event

In the absence of any input for these values, the DATASIM Program defaults to

- NDELT = 10
- IEVENT = 2 (perigee events)
- TIMSEE = 600.0 seconds

3.5.6.2.4 DODS Observation Tape Tracking Schedule

The DODS observation tape tracking schedule type is described as follows. A DODS observations tape is input to the DATASIM Program and observations are output at the same times and for the same stations as on the input tape. Thus, the tape completely defines the frequency of output.

There are no time station-dependent parameters for this mode. A DD card for unit 52, which defines the input observation tape, is required in the JCL (see Section 5).

3.5.6.2.5 Elevation Angle Constraints

In the DATASIM Program, the elevation angle constrains the output in the following two ways:

- The minimum elevation angle allowed determines when a station can or cannot observe the satellite.

- The elevation angle at which to start and end a satellite pass determines the start and end times of the pass.

The default minimum angle is 0.0 degrees for all tracking systems. To modify this value for a specific tracking system, input a TRACKELV keyword card with the tracking system number and the elevation angle. The default evaluation angle at which to start and end a satellite pass is 0.0 degrees. To modify this value to R_3, include a Station Card 7 keyword with the value R_3.

3.5.6.2.6 Types of Observations Output

By default, in a DATASIM Program run, all types of tracking data observations that can be measured by a station will be output. These include the following observables:

Station Type	Observation Types
VHF	Range, range-rate, X_{30}, Y_{30}
S-band	Range, range-rate, X_{30}, Y_{30}
Minitrack	Direction cosines and m
C-band	Range, azimuth, elevation
USB (30 foot)	Range, range-rate, X_{30}, Y_{30}
USB (85 foot)	Range, range-rate, X_{85}, Y_{85}

The station type is defined on the Station Card 1 keyword.

To modify these standard values, include a Station Card 8 keyword that contains the types of observations to be output. For example, to output range and range-rate from VHF or S-Band stations, include:

```
Columns    1  -   89 11        14
                  /*******8   1   9
```

where ******* is the station name and 1 and 9 are the observation type numbers for range and range-rate. Appendix A contains a complete list of observation type numbers. For

DODS observation tape tracking schedules, this option is not allowed. (See Section 3.5.13 for outputting attitude sensor data.)

3.5.7 RANDOM ERRORS AND BIAS ERRORS

Each output observation can be computed to include a random error or a bias error. By default these errors are not applied. To use either type of error, include in a DCOPT subdeck one or more of the following keyword cards: DSPEA2, or Station Card 5. These are described in the following two sections.

3.5.7.1 Random Errors

A random Gaussian error can be included in any simulated observation by inputting a DSPEA2 keyword card with a 1 in column 17. This will generate a random error with mean zero and a default standard deviation as defined in Appendix A.

If the user wishes to modify the default standard deviation of the error for any observation type, the OBSDEV keyword card with the modified standard deviations must be used.

3.5.7.2 Bias Errors

Each output observation can be modified by adding a bias error. This is done by including a Station Card 5 with the appropriate observation type number and bias value. (See Appendix A for the observation type numbers.)

A bias can be applied to the time tag. This is done by inputting a Station Card 5 with a 30 in columns 13 through 14 and the time bias value in columns 18 through 38. In this case, the time tag output with the observation will be the time prior to the application of the bias. For all bias errors, the bias is applied for the whole DATASIM timespan and is independent of satellite passes.

3.5.8 STATION ERRORS

In the DATASIM Program, geodetic errors can be applied to each station. This option allows for simple testing of the station recovery option in the DC Program by allowing modification of the station geodetics. The errors are, by default, not applied. To apply an error, a DCOPT subdeck should be included with a Station Card 8 keyword. The errors indicated on the keyword card are added to the geodetics contained in the Geodetics Working File, and the modified geodetics are used in observation computations. Another mode of inputting such errors is to input a Station Card 1 keyword with modified geodetic values.

3.5.9 FORCE MODEL CONSTANTS

The force model constants used in the DATASIM Program are the equatorial mean radius of the Earth (r_e), the flattening coefficient of the Earth (f), and the mean rotational rate of the Earth (ω). The values r_e and f are used for the calculation of satellite geographical coordinates, and is used for the calculation of the velocity of the local station coordinates. To modify the default values, include in an OGOPT subdeck the keyword cards BDROTATE, BODYRAD, or FLATCOEF to modify ω, r_e, or f, respectively.

Attitude data (constant right ascension and declination) are required for attitude sensor data simulation. The user must input the ATTANG1 and ATTANG2 keyword cards with the correct values for the DATASIM Program to simulate such data.

3.5.10 SLP EPHEMERIS FILE

The DATASIM Program requires the SLP Ephemeris File to

- Convert from lunar to Earth-centered coordinates
- Rotate from a mean equator and equinox of 1950.0 to TOD coordinates

If the permanent SLP Ephemeris File is not satisfactory for the DATASIM Program run, then, in the DMOPT subdeck, the SLPFILE keyword card and one or more of the following keyword cards are required: SLPBODY, SLPCOORD, SLPDEG. When this option is used, a JPL DE19 or DE96 format ephemeris tape on unit 34 is required as input. (See Section 3.8.4 for directions on the use of the keywords and Section 5 for JCL requirements for unit 34.)

3.5.11 OBSERVATION CORRECTIONS

The DATASIM Program can simulate observations that include ionospheric refraction, tropospheric refraction, transponder delay, or antenna mount modeling effects, and whose time tags include a light time correction. By default, these effects are not included. To allow for this option, include in a DCOPT subdeck the OBSCORR keyword card with a 1 in column 11. This will activate the DATASIM Program to perform the above modeling effects. In addition, the WORKIONO keyword card in a DMOPT subdeck is required to build an Ionospheric Refraction Working File, and the TRNDLY keyword cards are needed to create the transponder delay table. (See Section 4 for greater detail on the specific keywords.)

3.5.12 OUTPUT OPTIONS

Besides an Initial Conditions Report, the DATASIM Program can output the following:

- An Observation Report
- A Data Simulation Summary Report
- A Data Simulation Station Contact Report
- Intermediate Debug Output

A brief summary of each type of output and specific user options are presented in the remainder of this subsection. Modification of report options involves the keyword cards DSPEA3 and INTEROUT in a DCOPT subdeck or INTEROUT in an

OGOPT subdeck. In addition, a run identification title may be specified using the TITLE keyword card.

3.5.12.1 Observation Report

The Observation Report consists of a time tag [universal time coordinated (UTC)], station name, observation model effects, random and bias errors, elevation, true anomaly, height, and satellite revolution. By default, every observation is included. To output data only every nth observation, an n must be included in card columns 12 through 14 of the DSPEA3 keyword card.

3.5.12.2 Data Simulation Summary Report

The Data Simulation Summary Report prints the following items for each interval or pass of a station: start and end times, minimum and maximum elevation angles and associated times, first and last revolution numbers, number of observations, and, for minitrack stations, the east/west and north/south time of meridian crossing. This report is printed by default. To suppress this report, a DSPEA3 keyword card should be included with a 1 in card column 17.

3.5.12.3 Data Simulation Station Contact Report

The Data Simulation Station Contact Report is a condensed version of the Data Simulation Summary Report. The report prints the following data in tabular form for each revolution: station name, times of acquisition and loss of signal, time of maximum elevation angle, and elevation angle. This report is not printed unless specifically requested. To request the report, a DSPEA3 keyword card should be included, with a 2 in card column 11.

If the user wants the Data Simulation Station Contact Report but no output observation tape, only the DSPEA3 keyword card is required in a DCOPT subdeck. The card must have a 1 in column 11. The DATASIM Program will default to a periodic tracking schedule over the timespan defined by the ORBIT

File and will observe the satellite every 60.0 seconds. The user can change the start and end times and the observation frequency rate by inputting the proper data on the DSPEA1 and DSPEA2 keyword cards. JCL for output tapes is not required.

3.5.12.4 Intermediate Output

Intermediate output from various subroutines can be printed in NAMELIST form via the use of the INTEROUT keyword card. This is useful for system testing of program modifications.

3.5.13 ATTITUDE SENSOR DATA SIMULATION

The GTDS DATASIM Program was originally designed to simulate tracking data, which required that stations be used; however, attitude sensor data does not need station information. Therefore, a fictitious station 'SSSSSS' must be included in the DATASIM Program. In addition, attitude data, satellite spin rate, and the sensor monitoring angle are required. To simulate attitude sensor data, the following should be included.

- A Station Card 1 with '/SSSSSS' in card columns 1 through 7 and a 1 in card columns 9 and 11 must be included in the DMOPT subdeck.
- The attitude (constant right ascension and declination) must be specified via the ATTANG1 and ATTANG2 keyword cards in the OGOPT subdeck.
- The DSPEA1 keyword card must be included in the DCOPT subdeck and must indicate generation of a GTDS observation tape using a periodic tracking schedule (i.e., a 1 must appear in card column 11 and a 0 must appear in card column 14). The time-span and observation frequency may also be specified by the user.

- A Station Card 8 keyword with the desired observation types in card columns 11, 14, and 17 must also be included. The valid observation types are these:

  = 52, Sun angle
  = 53, Earth-in elapsed time
  = 54, Earth-out elapsed time
  = 55, Solar occultation

- The OASENSOR keyword card, with the satellite spin rate and sensor mounting angle, must be included in the DCOPT subdeck.

The attitude sensor data can only be generated on a GTDS observation tape. Observation biases can be applied by using a /SSSSSSƀ5 card and appropriate data.

3.5.14 SST DATA SIMULATION

The GTDS DATASIM Program was originally designed to simulate tracking data for only one satellite; however, ATS SST data requires an additional satellite and/or ground transponders. For input purposes, the additional satellite has a station name TARGET. The mode of the data, frequency indicator, type of range-rate and uplink frequency delta F also must be specified. To simulate SST data, the following input should be provided:

- Two ORBIT Files, one for each satellite
- WORKGEO card in the DMOPT subdeck containing all tracking stations and transponders; all stations must precede transponders
- A Station Card 8 for the tracking station in the DCOPT subdeck with the desired observation types in the integer fields

- The SSTSIM keyword card in the DCOPT subdeck with the FRN of the relay satellite ORBIT File, mode of data, frequency indicator, type of range-rate and uplink frequency delta F
- A RELAYID keyword card in the DMOPT subdeck specifying the relay satellite identification number; the target satellite ID is on the control card
- The DSPEA1 keyword card in the DCOPT subdeck indicating that a GDH tape (i.e., a 3 must appear in column 14) is to be output; either periodic or satellite pass tracking schedule may be used (a 1 or 2 in column 11)

Additional keyword cards must be included for the following tracking schedules:

- Periodic tracking schedule (a 1 in column 11 of DSPEA1 card)
  - A Station Card 1 with /TARGET in columns 1 through 7, a 1 in column 9, and an 8 in column 17 must be included in the DMOPT subdeck.
  - Time intervals and periods for tracking stations, transponders, and target satellite must be specified on Station Cards 7 and 9 with their respective station names. Time intervals for tracking stations and transponders (or target satellite) should overlap where SST data is to be simulated.
- Satellite pass tracking schedule (a 2 in column 11 of DSPEA1 card)

- Include a Station Card 7 for the tracking station with 1.D + 10 in columns 39 through 59. This specifies that the tracking station will be used for the entire length of the relay satellite pass. The transponder and target satellite are scheduled automatically.

SST data can only be output on a GDH tape.

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3.6 ANALYSIS PROGRAM

The ANALYSIS Program provides the capability to study the sources and propagation of errors in the least-squares solution of the orbit determination problem. Using simulated data from the DATASIM Program, the ANALYSIS Program computes the covariance matrix associated with a solve-for vector, given a tracking schedule and the variances of the observation measurement noise. The input solve-for vector is analogous to the estimation vector used in the DC Program. The ANALYSIS Program uses the same Bayesian weighted least squares algorithm as the DC Program but does not iterate, since the a priori value of the solve-for vector at epoch, which is supplied by the user, is assumed to be the best estimate. The ANALYSIS Program also has the capability of employing consider parameters to reflect the effects of errors in unadjusted parameters on the covariance matrix of the solve-for vector (see Section 3.2.1.9).

3.6.1 ERROR ANALYSIS REQUIRED KEYWORDS

The following keywords are required for an ANALYSIS Program run.

- CONTROL--Initiates the ANALYSIS Program run
- DMOPT--Identifies the subdeck type as the Data Management Subdeck
- WORKGEO--Builds Station Geodetics Working File (List of stations for WORKGEO)
- END--Indicates the end of the DMOPT subdeck
- DCOPT--Identifies the subdeck type as the DC Subdeck
- DSPEA1--Specifies tracking schedule
- DSPEA2--Specifies type of input ephemeris file

- END--Indicates the end of the DCOPT subdeck
- FIN--Terminates the input processor for error analysis input

The first card in the ANALYSIS Program input deck must be the CONTROL keyword card that initiates the ANALYSIS Program. Following the CONTROL card must be the DMOPT subdeck containing a WORKGEO keyword card to build a Station Geodetics Working File. Following the DMOPT subdeck must be a DCOPT subdeck that specifies the tracking schedule and the type of input ephemeris file via the DSPEA1 and DSPEA2 keyword cards. Additionally, any other desired keyword cards may be included within the DMOPT and DCOPT subdecks, respectively (see Sections 3.6.2.1 and 3.6.2.2). An OGOPT subdeck may also be included (see Section 3.6.2.3). The final card must be the keyword FIN. The ANALYSIS Program input deck can be followed by other program input decks that will cause execution of any of the GTDS programs.

In summary, the required input includes the following:

- Input ORBIT File with partial derivatives and epoch state vector
- Stations and tracking schedule

The ORBIT File must have been created previously, usually via the EPHEM Program.

3.6.2 ERROR ANALYSIS OPTIONAL KEYWORDS

Section 3.6.2 lists all the optional keywords that may be included in an ANALYSIS Program run. These keywords provide input of the following data types:

- List of solve-for parameters other than the Cartesian state; presently, in the consider mode, the solve-for parameters are limited to the state parameters

- Consider parameters
- A priori variances and covariances of the solve-for parameters
- A priori variances of the consider parameters
- Measurement variances
- Partial tracking times
- Mapping times
- Intermediate output requests
- Force model parameters

The keywords are given in the following sections. Many of these keywords are described in detail in Sections 3.1 and 3.2. (For details on the keyword formats and descriptions, see Section 4.)

3.6.2.1 Optional Data Management Keywords (DMOPT Subdeck)

The optional keyword cards in the DMOPT subdeck are as follows.

- DMOPT--Identifies the subdeck type as the Data Management Subdeck (not that this is required)
- OBSDEV--Sets input observation noise standard deviation
- SLPBODY--Sets central and noncentral bodies for generating the SLP Ephemeris Working File
- SLPCOORD--Sets SLP Ephemeris File coordinate system
- SLPDEG--Sets degree of curve-fit for bodies and rotation matrixes
- SLPFILE--Indicates source of planetary ephemeris data to create the SLP Ephemeris Working File
- WORKIONO--Builds Ionospheric Refraction Working File

- /*******(Station Cards 1 and/or 2)--Define station type, position, and dependent data

3.6.2.2 Optional DC Keywords (DCOPT Subdeck)

The optional keyword cards in the DCOPT subdeck are as follows:

- DCOPT--Identifies the subdeck type as the DC Subdeck
- CONSIDER--Invokes the consider mode
- CWEIGHT--Sets weighting factor constants
- INTEROUT--Permits writing of intermediate output
- MAPTIMES--Invokes epoch covariance matrix mapping option and specifies mapping times
- OBSCORR--Sets observation correction parameters
- PARTRTMS--Invokes partial tracking option and specifies partial tracking times
- TRACKELV--Sets minimum allowable elevation angle
- /*******(Station Cards 1, 2, 4, 5, 7, 8, and 9)--Specify station-dependent data

3.6.2.3 Optional Orbit Generator Keywords (OGOPT Subdeck)

The optional keyword cards in the OGOPT subdeck are as follows:

- OGOPT--Identifies the subdeck type as the Orbit Generator Subdeck
- CNM--Sets $C_{n,m}$ harmonic coefficients
- COVARNC--Sets the upper triangle of the a priori state covariance matrix
- DRAGCOF--Sets polynomial coefficients of ρ_1 by flight section

- DRAGPAR--Updates drag parameter and sets drag partial derivative switch
- DRAGPOLY--Sets the number of polynomial coefficients of ρ_1 to be solved for by section (see keyword DRAGCOF, Section 4)
- SCPARAM--Sets spacecraft parameters (area, mass, radius)
- SNM--Sets $S_{n,m}$ harmonic coefficients
- SOLRAD--Sets force model solar radiation option
- SOLRDPAR--Updates solar radiation parameter C_F and sets solar radiation partial derivatives switch
- STATEPAR--Sets state vector partial derivatives switch
- STATETAB--Sets required state parameters components to compute partial derivatives and/or solve-for state parameters
- TITLE--Allows input of various titles

3.6.3 STATIONS AND TRACKING SCHEDULE

The ANALYSIS Program stations and tracking schedule are completely specified as described in the DATASIM Program (see Sections 3.5.3, 3.5.4, and 3.5.6) by the DMOPT keyword WORKGEO with associated list of stations (for the tracking schedule) and by the DCOPT keywords DSPEA1, DSPEA2, and Station Cards 1, 2, 7, 8, 9.

3.6.4 INPUT ORBIT FILE

The input ORBIT File is specified as described in the DATASIM Program (see Section 3.5.5.1) via the keyword DSPEA2.

3.6.5 SOLVE-FOR PARAMETERS

The convention of solve-for parameter selection is the same as in the DC Program. See Section 3.2.1.8 for solve-for

parameter specification of both dynamic and local solve-for parameters and associated restrictions.

3.6.6 CONSIDER PARAMETERS

See Section 3.2.1.9, DC Consider Parameters, for a description of consider parameter specification in GTDS.

3.6.7 A PRIORI COVARIANCES (SOLVE-FOR AND CONSIDER)

Error Analysis Program covariance matrixes are handled as in the DC Program, which is described in Section 3.2.1.10.

3.6.8 OBSERVATION WEIGHTING

The standard deviation for each observation type, , and the observation weights, W, can be modified by the use of the keywords OBSDEV and CWEIGHT, respectively. See Section 3.2.1.13 for a more detailed description of these values.

3.6.9 PARTIAL TRACKING TIMES

The capability to compute a set of ANALYSIS Program solutions with subsets of the entire observation data span is available through the use of the DCOPT keyword card PARTRTMS. This card specifies the beginning and end times of partial tracking and the time interval between data subsets. The user also has the option to request a standard deviation breakdown in a designated coordinate system. The standard deviation breakdown provides the sensitivity matrix of partial derivatives of errors in the solution vector with respect to errors in the consider parameters. The variances of the solution parameters due solely to observation measurement noise are also included in this breakdown. For the coordinate system of sensitivity breakdown, the user can choose Cartesian, Keplerian, or orbit plane; the default is Cartesian. The DCOPT keyword CONSIDER must be included to make use of this option. The Partial Tracking Report

generated when partial tracking times are supplied is discussed in Section 3.6.11.1.

3.6.10 MAPPING TIMES

The capability to map the covariance matrix of the state at epoch to other times via a state transition matrix is available. To employ this capability, the DCOPT keyword MAPTIMES must be used. This card specifies the mapping start and end times and the time interval between mapping times. If the user supplies mapping start and end times that lie outside the ORBIT File start and end times, the mapping times are automatically defaulted to the ORBIT File start and end times.

The user also has the option to request a standard deviation breakdown in a designated coordinate system. The standard deviation breakdown provides the sensitivity matrix of partial derivatives of errors in the solution vector with respect to errors in the consider parameters. Also included are the variances of the solution parameters due solely to observation measurement noise. For the coordinate system of sensitivity breakdown, the user can choose Cartesian, Keplerian, or orbit plane; the default is Cartesian. The user can also request that the mapped covariance matrix associated with the last mapping time be printed out. The DCOPT keyword CONSIDER must be included to make use of the standard deviation breakdown feature.

3.6.11 SUMMARY OF ANALYSIS PROGRAM OUTPUT OPTIONS

The ANALYSIS Program provides as output an Initial Conditions Report, a Summary Tracking Report, a Partial Tracking Report, a Tabularized Summary Report, and a Mapping Report. In addition, a run identification title may be specified (TITLE keyword card). The Initial Conditions Report, Summary Tracking Report, and Tabularized Summary Report are obtained from every ANALYSIS Program run. The

Summary Tracking Report is based on all the observations collected over the entire tracking span. The report content is the same as that of the Partial Tracking Report. The remainder of this section discusses the Partial Tracking Report and Mapping Report, which are optional.

3.6.11.1 Partial Tracking Report

A Partial Tracking Report may be requested via keyword PARTRTMS; it will be printed based on the observations collected and the normal matrix accumulated up to that tracking time. The Partial Tracking Report contains the following information:

- Observation summary by station and by data type
- Epoch variance/covariance matrix (noise alone) and epoch solve-for variance/covariance matrix (consider mode) with associated correlation coefficients*
- Standard deviations of orbital elements and solve-for parameters at epoch
- Sensitivity breakdown of the consider parameters and measurement noise effects on the epoch solve-for parameters in a coordinate system designated on the PARTRTMS keyword card*

3.6.11.2 Mapping Report

The Error Analysis Program also provides the optional capability to map the epoch covariance matrix, resulting from the entire tracking span, to other times. The Mapping

*In the event that the normal matrix cannot be successfully inverted, only the observation summary by station and by data type is printed.

Report is controlled via the MAPTIMES keyword card and supplies the following information:

- Table of standard deviations of position and velocity and their respective components in a designated coordinate system (Cartesian or orbit plane)*
- Table of standard deviations of Keplerian elements*
- Optionally, the sensitivity breakdown of the consider parameters and measurement noise effects on the mapped solve-for parameters in a designated coordinate system (as specified on the MAPTIMES keyword card) at last map time
- The covariance matrix of the solve-for parameters with associated correlation coefficients at last map time only

3.6.12 PROCEDURE FOR MAKING AN ANALYSIS PROGRAM RUN

The following steps should be followed when setting up or executing the ANALYSIS Program.

- Select a set of solve-for and a set of consider parameters.
- Execute the EPHEM Program to compute partial derivatives of the state with respect to dynamic parameters that will be either solve-for or consider parameters in the ANALYSIS Program run and save the orbit and partial derivatives in an ORBIT File. There is a limit of 20 dynamic solve-for parameters.

  NOTE: The ORBIT File must be generated in a previous run or job step.

*For each standard deviation, the component of that standard deviation due solely to measurement noise is also printed.

The timespan of the ORBIT File must be long enough to accommodate the error analysis tracking schedule and all mapping times.

- Specify stations, tracking schedule, and observation data types to be computed by use of Station Cards 1, 7, 8, and 9. To insert values for the standard deviations for measurement noise different than the default values, use the DCOPT keyword OBSDEV. Similarly, to replace the default observation weights with different values, use the DCOPT keyword CWEIGHT.

- Provide start and end times for the ANALYSIS Program run by use of DCOPT keywords DSPEA1 and DSPEA2. The epoch time is supplied by the ORBIT File; in the absence of user-supplied start and end times, the start and end times of the ANALYSIS Program run default to the start and end times of the ORBIT File.

- For partial tracking reports, include the PARTRTMS card in the DCOPT subdeck with the start and end times and the interval for these reports. The option for a sensitivity breakdown may also be included if desired. Partial tracking start and end times lying outside the ANALYSIS Program start and end times will default to the ANALYSIS Program start and end times.

- To map the covariance matrix associated with epoch to other times, include, in the DCOPT subdeck, the MAPTIMES keyword card with start and end times and the interval between mapping reports. The option for a sensitivity breakdown may also be included if desired. Mapping start and end times lying outside

the ORBIT File start and end times will default to the ORBIT File start and end times.

- The ANALYSIS Program will default to six Cartesian solve-for parameters and no consider parameters.
- To include other solve-for and consider parameters, add the appropriate DCOPT keywords such as STATEPAR, STATETAB, SOLRDPAR, DRAGPAR, CNM, and SNM (see Section 3.2.1.8).
- If there are any station locations or observation biases in the problem, include these by the use of Station Cards 4 and 5. Include the DCOPT keyword CONSIDER if the ANALYSIS Program is to be run in the consider mode.
- A nonzero initial covariance matrix may be supplied by use of the keyword COVARNC in an OGOPT subdeck. Also supply variances for each consider parameter.

For details of all keyword cards, see Section 4.

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3.7 COMPARE PROGRAM

The function of the COMPARE Program is the comparison and merging of the trajectory data of a given satellite from two overlapping input ephemeris files. The comparison capability permits a determination of the relationship between various attributes of two trajectories over a comparison time interval specified by the user.

The two existing ephemerides can be compared at each ephemeris common point by using one of the following techniques:

- Match Variable-Step Ephemeris File elements
- Match Fixed-Step Ephemeris File elements
- Interpolate Variable-Step Ephemeris File elements

(See Section 3.1.7.1 for description of Variable-Step and Fixed-Step Ephemeris Files.)

The comparison can be either in inertial position, inertial position and velocity, or in terms of a spherical coordinate system rotating with the Earth. Tabulated differences between the two ephemerides are printed, and the minimum and maximum differences are identified.

Closely associated with this comparison is the capability to join two ephemerides to produce a single merged ephemeris. The merged ephemerides are those of the same satellite, taken over partially overlapping intervals of time. The time at which the merge is effected is chosen as the time at which the magnitude of the difference in the position vectors is a minimum.

The comparison and merge capabilities must be executed independently (i.e., both a comparison and merge cannot be requested in a single GTDS program execution).

3.7.1 EPHEMERIS COMPARISON REQUIRED KEYWORDS

The following keywords are required for a COMPARE Program run.

- CONTROL--Initiates the COMPARE Program run
- COMPOPT--Identifies the subdeck type as the Ephemeris Comparison Subdeck
- CMPEPHEM--Indicates the files to be compared and the type of comparison to be performed, and sets comparison limits and interval
- END--Specifies the end of the CMPOPT subdeck
- FIN--Indicates the end of the input deck for the COMPARE Program

The first card in the COMPARE Program input deck must be the CONTROL keyword card that is used to initiate the COMPARE Program. The CONTROL card must be followed by a COMPOPT subdeck specifying, via the CMPEPHEM keyword card, the input ephemeris files to be compared and the type of comparison to be performed. Plot option is also specified in this subdeck if desired. Following all options in the COMPOPT subdeck, an END card must appear specifying the end of the COMPOPT subdeck, followed by a FIN card indicating the end of the COMPARE Program input deck. Section 4 contains descriptions of each keyword card format.

3.7.2 EPHEMERIS COMPARISON OPTIONAL KEYWORDS

Section 3.7.2 lists all the optional keywords that may be included in a COMPARE Program run. If these keywords are used, they should be included in the COMPOPT subdeck. The keywords are as follows:

- CMPPLOT--Requests printer plot output of comparison differences and, optionally, sets the number of pages per plot and scale factors

- CMPTITLE--Indicates that n following cards are to be read as user titles for plots ($1 \leq n \leq 3$)
- HISTPLOT--Sets history plot options
- HSTSCALE--Sets history plot scales
- CMPFILES--Selects the FRNs and the step-size type, either variable step or fixed step, of the two EPHEM Files. This card must be present when comparing Variable-Step Size Ephemeris Files.

3.7.3 EPHEMERIS COMPARISON INPUT

The COMPARE Program uses two types of input, control information and ephemeris file input. The control information that may be specified can be classified as follows:

- Input ephemeris file types (ORBIT File, ORB1 File, or EPHEM File)
- Types of comparison (in terms of inertial position, inertial position and velocity or a spherical coordinate system)
- Level and partial derivatives indicators for ORBIT Files
- Comparison span and interval
- Compare technique: variable-step match, fixed-step match, or variable-step interpolation
- Optional comparison point selection
- Optional plot data and titles

The input ephemeris files used by the COMPARE Program must have been previously created either in another step of the same job or in another job. Both files must be of the same type, since the COMPARE Program cannot compare files of different types (e.g., an ORB1 File cannot be compared to an

ORBIT File). It is permissible, however, to compare a sequential ORBIT File to a direct access ORBIT File, an ORBIT File with partial derivatives to an ORBIT File without partial derivatives, or two levels within the same direct access ORBIT File. The input file types and the type of comparison must be specified on the CMPEPHEM keyword card. (For more details, see the description of the CMPEPHEM keyword in Section 4.) The level and partial derivative indicators associated with the ORBIT Files are also specified on the CMPEPHEM keyword card.

The comparison span is the entire timespan over which the comparison is to be made. This span must be included in the timespan covered by both input ephemeris files (i.e., the comparison span must be within the timespan overlap of the files). The user should note that there are no default values for the timespan; it must be specified on keyword card CMPEPHEM.

The last value that is specified on the CMPEPHEM keyword card is the comparison interval. This is the time between comparison points. For details on selecting a comparison interval, see the CMPEPHEM keyword card description in Section 4.

The optional plot data and titles allow the user to request printer plots of the computed differences. For information on these options, see the CMPPLOT and CMPTITLE keyword card descriptions in Section 4.

3.7.4 EPHEMERIS COMPARISON OUTPUT

COMPARE Program output consists of initial, comparison, and summary reports. The initial report identifies the satellite, the comparison interval, and the epoch and elements for both input ephemerides. The summary report consists of

the minimum and maximum position and velocity differences, and the associated times and RMS values.

The COMPARE Program outputs two types of comparison reports. The position and position/velocity comparisons result in the computation of the differences in the components and magnitudes of the position and velocity vectors at corresponding times within the comparison time interval. These differences are reported in rectangular coordinates in a satellite-oriented coordinate system defined by the position and velocity vectors on the earlier ephemeris at the time of the comparison. These track-oriented differences are computed in a nonorthogonal system as follows:

Origin: Center of reference body

Reference plane: The plane of the orbit

Principal direction: The radius vector

Components:	R (radial)	- Along the radius vector
	C (cross-track)	- Along the vector R x A
	A (along-track)	- Along the satellite's velocity

All differences are displayed as (secondary file) - (primary file), where the files are indicated as primary or secondary on the CMPEPHEM input keyword card. The associated time of comparison and the true anomaly computed from the second ephemeris are also reported.

The second type of comparison report, sometimes termed a world map comparison, results in the computation and printing of the geodetic latitude, longitude, and spheroid heights for each ephemeris, along with the associated time of comparison.

Printer plots of track-oriented and position and velocity component differences as a function of time are also optionally available. If the option is chosen, each component

will appear on a separate plot. Normally, each plot is scaled to the data and will occupy one printed page; however, the user may provide his or her own scales, with each plot extending up to 10 pages. All plot options are controlled by the CMPPLOT, CMPTITLE, HISTPLOT, and HSTSCALE keyword cards.

3.7.5 EPHEMERIS MERGE REQUIRED KEYWORDS

The following keywords are required for an Ephemeris Merge Program run.

- CONTROL--Initiates the COMPARE Program run
- COMPOPT--Identifies the subdeck type of the COMPARE Program Subdeck
- EPHMERGE--Indicates the files to be merged and sets the merge criterion
- END--Specifies end of the COMPOPT subdeck
- FIN--Indicates the end of the input deck for the COMPARE Program

For the merge capability, the first card in the COMPARE Program input deck must be the control keyword card that is used to initiate the COMPARE Program. The control card must be followed by a COMPOPT subdeck specifying, via the EPHMERGE keyword card, that the input ephemeris files are to be merged. Following the EPHMERGE card, an END card must appear specifying the end of the COMPOPT input subdeck. No other COMPARE Program optional keyword cards are allowed with the EPHMERGE keyword card.

3.7.6 EPHEMERIS MERGE INPUT

The COMPARE Program merge capability requires two forms of input: control information and ephemeris file input. The control information is the maximum acceptable difference in

position vector magnitudes within the overlapping time interval of the ephemerides to be merged. The tolerance is specified on the EPHMERGE keyword card, and the merge will be performed only if this criterion is satisfied.

The ephemeris input must be in the EPHEM File format and must have been generated in an earlier run. The two ephemerides must be of the same satellite and must have been taken over partially overlapping intervals of time. ORB1 and ORBIT File merges are not currently supported.

3.7.7 EPHEMERIS MERGE OUTPUT

Ephemeris Merge printed output consists of initial and summary reports. The initial report identifies the satellite and gives, for both input ephemerides, epoch and epoch elements in Cartesian and classical forms. The summary report gives the span of data used from each input ephemeris, the total timespan of the merged file, and the position and velocity vectors from each input ephemeris at the time of the merge.

The other output is a composite trajectory determined by the merging of the two input ephemerides. The resultant ephemeris is output in the EPHEM File format to magnetic tape or disk.

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3.8 DATAMGT PROGRAM

The function of the DATAMGT Program is to build working files of data for use by another program in the system. The user can specify either that the DATAMGT Program operate as a part of another program, that is, to use the working files, or that the DATAMGT Program operate as a standalone program to build working files for a future job step. All programs in GTDS, with the exception of the COMPARE Program and the Permanent File Report (FILERPT) Program, require the use of the DATAMGT Program. Many working files specified for action by DATAMGT may have their contents reported.

The file-building operations that can be specified are these:

- Merge observations from various sources into a single working file on disk
- Generate a file of SLP ephemeris curve-fit coefficients from a JPL planetary ephemeris tape
- Retrieve data from the GTDS online data base and store it in main memory. The files in the online data base include the following:
    - Astrodynamic Constants File
    - Atmospheric Density Models File
    - Earth Potential Fields File
    - Flight Sectioning Models File
    - Integration Coefficients File
    - Ionospheric Refraction Generalized Coefficients File
    - Lunar Potential Fields File
    - GTDS Permanent Elements File

- Solar Flux Data File
- SLP Ephemeris File
- Impulsive Maneuvers File
- Time Conversion Coefficients File
- Tracking Station Geodetics File
- Tropospheric Data File
- 24-Hour Hold Elements File

3.8.1 DATA MANAGEMENT REQUIRED KEYWORDS

Keywords required for a DATAMGT Program run are as follows:

- CONTROL--Initiates the DATAMGT Program
- DMOPT--Identifies the subdeck type as the Data Management Subdeck

  One or more optional DMOPT keywords
- END--Specifies end of the DMOPT subdeck
- FIN--Indicates end of program input deck for the DATAMGT Program

The first card in the DATAMGT Program input deck must be the CONTROL card with the word DATAMGT in card columns 11 through 18. This will initiate the DATAMGT Program. A DMOPT subdeck must follow the CONTROL card. The appropriate cards for each desired data management option must be included (see Section 3.8.2), followed by an END card. The last card must be a FIN card indicating the end of the DATAMGT Program input deck. The DATAMGT Program input deck can be followed by the program input deck for another GTDS program (such as DC or EPHEM), which needs the working file data. (See Section 4 for complete descriptions and formats of all keyword cards.)

3.8.2 DATA MANAGEMENT OPTIONAL KEYWORDS

This section lists all the optional keywords that may be included in a DATAMGT Program run. Any of these keywords that are selected must be included in the DMOPT subdeck. The keywords are classified as observation working file generation keywords, SLP Ephemeris File generation keywords, and data base retrieval keywords, respectively. The keywords in each classification are listed below. Detailed descriptions of these keywords appear in the following text and in Sections 3.1 and 3.2.

- Observation Working File Generation Keywords
  - Aƀƀƀ****--Specifies the acceptance criteria for editing observations (**** is a four-letter station acronym)
  - ACCREJ--Specifies the number of accept or delete cards that follow
  - Dƀƀƀ****--Specifies the deletion criteria for editing observations (**** is a four-letter station acronym)
  - MAXOBS--Sets the maximum number of observations to be accepted from the 60-byte observation tape or data base
  - WORKOBS--Creates Observations Working File

    /*******1--Specifies tracking station dependent information

    /*******2--Specifies tracking station dependent information
- Specification of parameters for real-time (partial batch) request for data currently being collected within TCOPS

- RTSATID--Specifies all satellite IDs for which partial batch data are to be requested
- RTPARAMS--Specifies the partial batch request parameters
- RSTA****--Specifies the tracking station for which partial batch data are to be requested
- RSYS****--Specifies the tracking system for which partial batch data are to be requested
- SLP Ephemeris File Generation Keywords
  - SLPBODY--Sets central and noncentral bodies
  - SLPCOORD--Sets SLP ephemeris coordinate reference
  - SLPDEG--Sets degree of curve-fit for bodies and rotation matrixes
  - SLPFILE--Sets source of SLP data to be used in creating a working file
- Data Base Retrieval Keywords
  - WORKATM--Retrieves model from the Atmospheric Density Models File (Harris-Priester data only)
  - WORKCON--Retrieves model from the Astrodynamic Constants File
  - WORKELS--Retrieves elements from GTDS Permanent Elements File or 24-Hour Hold Elements File
  - WORKGEO--Retrieves data for specified stations from Tracking Station Geodetics File
  - WORKINT--Retrieves model from Integration Coefficients File

- WORKIONO--Retrieves data from Ionospheric Refraction Generalized Coefficients File
- WORKMAN--Builds Impulsive Maneuvers Working File
- WORKSECT--Retrieves model from Flight Sectioning File
- WORKTCOR--Retrieves data from Time Conversion Coefficients File

Section 4 contains individual keyword descriptions with details on card formats and definitions.

3.8.3 OBSERVATION WORKING FILE GENERATION

The DATAMGT Program is frequently used to merge observations from various sources into a single Observations Working File required for all DC Program runs. In DC Program input decks, the mandatory OBSINPUT keyword card will trigger generation of the Observations Working File. In a DATAMGT Program input deck, however, the WORKOBS keyword card (in the DMOPT subdeck) is used for this purpose.

Therefore, both OBSINPUT and WORKOBS keyword cards must never be used in the same DC input deck. The following discussion applies to the working file generation that will take place when either of these cards is present. Observations from any of the following sources can be specified through the OBSINPUT or WORKOBS keyword cards:

- DODS observations tape (100-byte format)
- GTDS format observations tape
- GTDS format observations disk file
- PCE observations tape (an ORB1 File containing the satellite ephemeris in the form of the position and velocity vector components that are used as observations)
- GDH tape (60-byte format)

- 60-byte observation data base
- 60-byte real-time metric tracking data file (partial batch)
- GTDS observations card file
- Onboard attitude sensor data
- Landmark data card file

The WORKOBS keyword allows for specifying the timespan of the observations to be accepted in the first and second real fields of the card. The epoch associated with the output observation data set must also be provided in the third real field. This epoch must be the same as the epoch of the DC Program run that will use the Observation Working File.

The WORKOBS keyword provides for specification of any of the previously listed observation sources. Up to three integer fields per card, as well as multiple WORKOBS cards, can be used to indicate multiple observation sources. The integer source indicators are given in the WORKOBS keyword description (see Section 4). Any of the sources previously listed may be combined. The following sample keyword card

```
WORKOBS 1  3  12  810101000000.  810102000000.  810101000000.
```

requests a merge of observations from a GTDS observation tape (source number 1), a DODS observation tape (source number 3), and a GDH tape (source number 12). The observations working file will cover the timespan from January 1, 1971 (810101) to January 2, 1971 (810102), and will epoch at January 1, 1981 (810101).

Other DMOPT subdeck keywords can be used to perform editing when building the Observations Working File. The editing criteria consist of the following:

- The timespan for which observations are to be rejected (or, optionally, accepted)

- The types and modes of observations to be rejected (or, optionally, accepted)
- The station identifiers for which observations are to be rejected (or, optionally, accepted)
- An indication that every nth observation that passes all other editing criteria can be rejected (or, optionally, accepted)

The keywords used to invoke these options are ACCREJ, Abbb**** and Dbbb****. (See descriptions in Section 4 for these keyword cards.)

In some cases, a station is known to be present in an observation source but not present in the Tracking Station Geodetics File. Such new stations can be defined through the /*******1 and /*******2 keyword cards in the DMOPT subdeck. When preparing these cards, the new station name replaces the asterisks. The first station card /*******1 is used to describe the station type and position, and the second card /*******2 can optionally be included for nonstandard station-dependent data definitions (e.g., antenna offset, transmitter frequency).

3.8.4 SLP EPHEMERIS FILE GENERATION

GTDS can access SLP Ephemeris Files referenced to the mean equator and equinox of 1950.0 or the true equator and equinox of date. The GTDS SLP files currently contain data from December 1981 to March 1990, based on JPL DE118 SLP ephemeris. There will be instances when these existing files cannot be used, e.g., when the desired timespan extends beyond the December 1981 to March 1990 span on the file or when the user wishes to modify the planetary bodies on the file or the degrees of the Chebyshev polynomials. In

such cases, the user must supply DMOPT subdeck keyword cards to specify the generation of a new SLP File (see Reference 12).

The DATAMGT Program includes the following optional capabilities related to the generation of the SLP Ephemeris File.

- Generates an SLP Working File using a JPL planetary ephemeris tape as the data source (DE-19- or DE-96-format JPL tape)
- Generates an SLP tape file using a JPL planetary ephemeris tape as the data source (DE19- or DE96-format JPL tape)
- Generates an SLP Working File using an SLP tape file as the data source
- Bypasses generation of an SLP Working File and uses the last previously created SLP Working File

GTDS has the capability of using JPL ephemeris tapes as input to create an SLP File consisting of Chebyshev coefficients. However, this capability is restricted to use as input, a JPL ephemeris tape in the DE-19 or DE-96 tape format (see References 7, 8, 9, and 10). GTDS cannot accept as input the newer JPL tape format of DE-114; however, DE-118 is compatible. The DE-19 and DE-96 formats are not compatible. A GTDS user must make certain that an input JPL tape is in the DE-19 or DE-96 format and consistent with the SLPFILE keyword specification.

A DE-96 JPL tape is converted to an SLP Ephemeris File for use in GTDS by use of TRAMP. The DE-19 format tape cannot be processed by TRAMP, however. The TRAMP User's Guide (Reference 6) describes the method of creating SLP Files using TRAMP.

The SLP Ephemeris File generation option is specified on the SLPFILE keyword card (in the DMOPT subdeck), along with data relating to the start time of the file, the number of days per record, and the number of records. By default, the SLP Working File generated by the DATAMGT Program employs the Earth as the central body, the Moon as the fast body, and a maximum of seven slow bodies.

The degree of the Chebyshev curve-fit for the Moon's position is 19, the Moon's velocity is 12, and the Sun's position is 9. Twenty days of data are included in each record. Rotation matrixes are represented by polynomials of degree 9. All data are in a coordinate system in which the x-axis is referenced to the mean equator and equinox of 1950.0. To change any of these default values during an SLP Ephemeris File generaton, the following DMOPT subdeck keyword cards are required.

Keyword	Description
SLPCOORD	Specifies coordinate reference. A true-of-date coordinate reference can be supplied to override the 1950.0 default.
SLPBODY	Specifies the SLP central body, the fast body, and a maximum of seven slow bodies. Multiple SLPBODY cards can be used (the necessary body indexes are shown in Table B-1 of Appendix B).
SLPDEG	Specifies the degree of curve-fits for the rotation matrixes, fast body position, fast body velocity, and slow body positions. (The maximum degree which can be specified is 19.)

In the following example, an SLP Working File is to be generated from a JPL DE96 format planetary ephemeris tape. The SLP Ephemeris File is to contain 150 days of data with 15 days on each record. The file is to use the TOD coordinate system reference, with Earth as the central body, the Moon as the fast body, and five other slow bodies. Chebyshev

polynomials fit to the rotation matrix are to be of degree 8, to the Moon's position of degree 12, to the Moon's velocity of degree 8, and to the slow body positions of degree 9. Following the card formats specified in Section 4, the following keyword cards would be required:

```
SLPFILE      5  15  10  730101.
SLPDEG       8  12   8    9.0
SLPBODY      1   2   3    4.0  5.0  6.0
SLPBODY     10  11
SLPCOORD     2
```

3.8.5 RETRIEVING FROM THE GTDS PERMANENT ONLINE DATA BASE

Data base retrieval allows the user to modify certain EPHEM Program and DC Program data by retrieving a particular model from a file in the GTDS permanent online data base. FILERPT Program output can be examined prior to selecting a model for retrieval. Optional cards can then be used in the DMOPT subdeck of a DATAMGT Program run to specify retrieval of the data in the desired data model. The files from which data can be retrieved are listed with associated keyword cards in Section 3.8.2. The following discussion describes the use of these keywords for retrieving particular types of data.

Elements retrieval (WORKELS keyword) is from one of two files: the GTDS Permanent Elements File or the 24-Hour Hold Elements File. The GTDS Permanent Elements File contains elements for spacecraft supported by GTDS. The elements are selected by the operations analyst responsible for spacecraft support. The 24-Hour Hold Elements File contains elements from DC Program runs and can be accessed by all GTDS users.

If retrieval is requested from the GTDS Permanent Elements File or the 24-Hour Hold Elements File, a unique element set

number associated with each element set is used as the retrieval key.

The remaining files in the GTDS data base are either used only with special options or have the most commonly used versions in COMMON blocks in memory. The Ionospheric Refraction Generalized Coefficients File is used only for refraction modeling in the DC Program, and DATAMGT Program retrieval is required only for those cases. Station geodetics retrieval and timing coefficients retrieval are always automatic (except for DATASIM Program cases), so the DATAMGT Program need not be explicitly called to obtain these data. Default values for data contained on the other files reside in COMMON blocks, but they can be overridden by DATAMGT Program data base retrieval options.

For most files, the models or data elements in the files are stored one model or data element per record, and retrieval is by model number (see Appendix D for available model numbers). The following files are exceptions:

- Impulsive Maneuvers File (WORKMAN keyword)--Each maneuver has a maneuver number and an associated time. Retrieval is by maneuver time or by specified maneuver numbers.

- Tracking Station Geodetics File (WORKGEO keyword)--Each geodetic record is identified by an 8-byte Extended Binary Coded Decimal Interchange Code (EBCDIC) station name and a station index number. Retrieval of geodetic information is by individually specified station names or station index numbers.

- Refraction Data Retrieval (WORKIONO keyword card)--Retrieval from the Solar Flux Data File and the Ionospheric Refraction Generalized Coefficients File is based on the timespan specified for the run. The refraction model (Bent or Novak) selection for the run is also made through this card. The WORKIONO keyword causes the creation of an intermediate refraction coefficients working file from data on the two previously mentioned permanent files. The Novak model uses this intermediate file to generate an Ionospheric Refraction Working File. However, the Bent model can specify, through the use of WORKIONO, either for creation of the intermediate file or the use of an intermediate file saved on a previous run (which saves processing time). The Bent model also uses data from the Tropospheric Data Permanent File, but retrieval from this file is performed during the DC Program processing and is outside the DATAMGT Program.

- Time Conversion Coefficients File (WORKTCOR keyword card)--A.1/UTC time conversion data and polar motion data are retrieved on the basis of data specified on the keyword card.

Section 4 contains the complete descriptions and formats of the individual file retrieval keywords.

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3.9 FILERPT PROGRAM

The FILERPT Program is to provide printer reports of files resident in the GTDS permanent data base. Reports of the following permanent files are available through this program.

- Astrodynamic Constants File
- Atmospheric Density Models File
- Earth Potential Fields File
- Flight Sectioning Models File
- GTDS Permanent Elements File
- Impulsive Maneuvers File
- Integration Coefficients File
- Lunar Potential Fields File
- SLP Ephemeris File
- Tracking Station Geodetics File
- 24-Hour Hold Elements File

A typical use of the FILERPT Program reports is to determine which permanent file data may be appropriate for later use in either a DATAMGT Program run or in the data management operation of another GTDS program. The PFROPT subdeck, which controls the functions of the FILERPT Program, may be included in any of the other GTDS programs, thus enabling the FILERPT functions without the use of the FILERPT Program.

3.9.1 PERMANENT FILE REPORT GENERATION REQUIRED KEYWORDS

The following are the keywords required for a FILERPT Program run:

- CONTROL--Initiates the FILERPT Program run
- PFROPT--Identifies the subdeck type as the File Report Subdeck
- One or more optional PFROPT keywords

- END--Specifies end of PFROPT subdeck
- FIN--Indicates end of FILERPT Program input deck

The input data consist of a CONTROL card containing the word FILERPT in card columns 11 through 18; this will invoke the Perma- nent File Report Generation Program. A PFROPT subdeck must follow the CONTROL card and contain keyword cards to provide specifications for the desired reports. Finally, an END keyword card must be included to indicate the end of the subdeck, followed by a FIN card to indicate the end of the program input deck for the FILERPT Program. (Section 4 contains complete descriptions and formats of all the individual keywords.)

3.9.2 PERMANENT FILE REPORT GENERATION PROGRAM OPTIONAL KEYWORDS

This section lists all the optional keywords which may be included in a FILERPT Program run. The keyword cards, if used, must be included in the PFROPT subdeck. A keyword cannot appear more than once in one PFROPT subdeck. To re- quest additional reports from a keyword, multiple PFROPT subdecks may be included. The optional keywords and their associated reports are as follows.

- ATMOSRPT--Atmospheric Density File Report
- CONSTRPT--Astrodynamic Constants File Report
- ELSRPT--GTDS Permanent Elements File Report
- ELS24RPT--24-Hour Hold Elements File Report
- EPOTRPT--Earth Potential Fields File Report
- GEODRPT--Tracking Station Geodetics File Report
- INTCRPT--Integration Coefficients File Report
- LPOTRPT--Lunar Potential Fields File Report
- MANURPT--Permanent Maneuvers File Report
- SECTRPT--Flight Sectioning File Report
- SLPRPT--SLP File Report by matrix order

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3.10 THMODEL PROGRAM

The THMODEL Program of GTDS provides the capability of estimating thrust parameters for a short-burn maneuver (firing of the upper stages of an ELV). A spacecraft orbit frame coordinate system is used to model maneuvers. Rates of pitch, yaw, and thrust acceleration are assumed constant during a burn. Nominal maneuver parameters determined prior to launch by this program will be independent of the actual lift-off time and will be used after launch by the GTDS EPHEM Program that has been slightly modified to propagate orbit through burns.

The software development of the THMODEL program is based on algorithms defined in Reference 15. In this model, a maneuver is characterized by time and mass of vehicle at ignition, time and mass of vehicle at burnout, pitch angle, yaw angle, thrust acceleration at ignition, and pitch rate, yaw rate, and thrust acceleration rate.

The method of determining these parameters assumes that both ignition and burnout state vectors are known. These vectors are read by the program from a vector hold file created by ADG using mission planning data. An initial estimate of thrust parameters is made based on the difference between the state vector at burnout and the vector propagated to the time of burnout from the ignition state vector using free flight. An iterative method then is invoked to successively refine the estimate until the convergence test is passed or a user-specified maximum number of iterations is reached.

The THMODEL program outputs its result to the GTDS FSF, which will be used as input to the EPHEM program for orbit propagation through burns and sends a report to the user.

The THMODEL Program has to be run standalone. Stacked EPHEM may not be executed together with it.

3.10.1 THRUST PARAMETER MODELING REQUIRED KEYWORDS

The following keywords are required for a THMODEL Program run.

- CONTROL--Initiates the THMODEL Program run
- OGOPT--Identifies the subdeck type
- THSHORT1--Indicates FSF output option, maximum number of iterations, maximum freeze number, and maximum tolerance in position for the convergence test
- THSHORT2--Indicates option to output processing result at each iteration, matrix option, and maximum tolerance in velocity for the convergence test
- THSHORT3--Indicates changes in pitch, yaw, and thrust acceleration to be used for the computation of the correction matrix
- THSHORT4--Indicates changes in pitch rate, yaw rate, and thrust acceleration rate to be used for the computation of the correction matrix
- THSHORT5--Indicates maneuver number, record numbers for ignition and burnout vectors from the TVHF, and time of ignition and burnout
- END--Specifies the end of the OGOPT subdeck
- FIN--Indicates the end of the input deck for the THMODEL

There are no optional keywords for the THMODEL Program.

3.10.2 THRUST PARAMETER MODELING INPUT

The THMODEL Program uses two types of input: keyword cards and vector hold file. Data specified in keywords are for control information that can be classified as follows.

- Option to output result to FSF and to user
- Data to control the numerical technique of thrust estimation
- Type of thrust parameter model (i.e., matrix option)
- Maneuver information (maneuver number and time of ignition and burnout)
- Information to get input from a TVHF (record numbers)

Data read from a TVHF consists of the following information.

- A nominal ignition state vector (Cartesian)
- A nominal burnout state vector (Cartesian)
- Time and spacecraft mass at ignition
- Time and spacecraft mass at burnout
- Force model parameters for orbit propagation (e.g., drag, solar radiation, spacecraft cross-sectional area)

See details and descriptions of THMODEL keywords in Section 4.

3.10.3 THRUST PARAMETER MODELING PROCESSING DESCRIPTION

The THMODEL Program proceeds as follows.

1. Read input data from keyword cards (for control parameters) and from a vector hold file (for nominal ignition and burnout states).

2. Ignition state vector is propagated to the time of burnout, assuming no thrust.

3. First guess of thrust coefficients is made based on the miss vector at burnout.

4. Ignition state vector is propagated to the time of burnout using the newly estimated thrust. The new miss vector is calculated.

5. A convergence test is applied to determine if the state vector derived in step 4 is acceptable. If it is or if the maximum number of iterations is already reached, skip step 6.

6. A correction to thrust coefficients is made based on a first-order Taylor series expansion of the mission vector, and go to step 4.

7. Write result to the FSF as requested and write report to user.

3.10.4 THRUST PARAMETER MODELING OUTPUT

The output of the THMODEL Program mainly consists of the following thrust coefficients for a specified burn.

- Pitch angle, yaw angle, and thrust acceleration at ignition
- Pitch rate, yaw rate, and thrust acceleration rate during the burn

If the matrix option 0 is requested via keyword card THSHORT2, the three last coefficients are assumed zeros for the thrust model.

The THMODEL Program outputs its result to the FSF and a report to the user. When writing onto FSF, it overrides all thrust coefficients for the specified burn written

previously in FSF for the same satellite. Note that THMODEL has options to output to FSF result from the last iteration or from the best estimate or not to output to FSF. For each satellite in FSF, there can be a maximum of 11 flight sections including up to 5 maneuvers. Information for maneuver 1 goes to flight section 2, information for maneuver 2 goes to flight section 4, etc.

Section Appendix H for a sample of THMODEL Program output.

Information included in the FSF can be used after launch for an orbit propagation through burns via an option specified in keyword card BURNFSF. Before using this option, be sure that all other information indicated in the FSF for this satellite has been entered or updated via appropriate UI panels. The Launch processor also has a capability of updating the actual lift-off time directly to FSF to maintain the accuracy of postlaunch orbit propagation using information from this file.

3.10.5 THRUST PARAMETER MODELING PROGRAM RESTRICTIONS

The THMODEL Program is used to estimate only thrust coefficients for short-burn maneuvers.

Estimated thrust coefficients can be used to generate a real-time postburnout state from a preignition state via normal orbit propagation processes. However, as they do not represent the real thrust, they are not to be used to estimate a state vector at the middle of a burn.

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3.11 GTDS AS A SUBTASKED LOAD MODULE

GTDS can execute as a subtask of the TCOPS Executive in two distinct modes (GTDS and GUI subtasked, and GTDS and Driver Task subtasked), which will be discussed in Sections 3.11.1 and 3.11.2.

These two modes do not present GTDS programs, but they do present the user with the special information needed to execute GTDS in these environments.

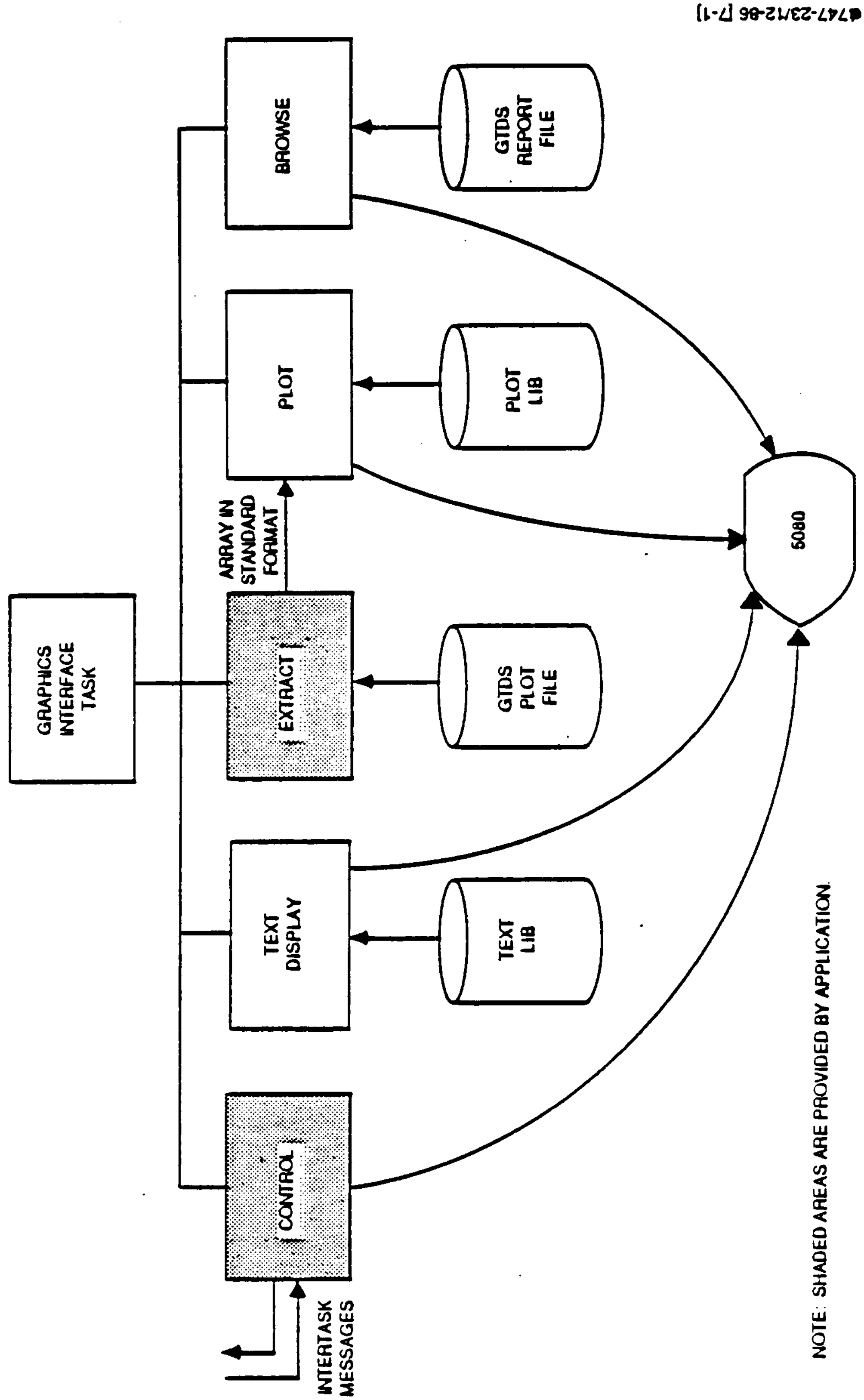
It should be noted that the general GSFC user community will not use the propagator. Section 3.11.2 presents information that a programmer/developer needs.

3.11.1 GTDS GUI

This section describes the GTDS GUI, which allows the user to run GTDS programs via menu and data entry panels. The new user interface for GTDS has been built around the TEMPLATE text and plot display capabilities.

3.11.1.1 GTDS Graphics User Interface Environment

Figure 3-1 shows the subtask structure used for GTDS support in 5080 graphics mode. For standard GTDS processing, the user submits a job via the GUI. The GUI sends an intertask message to GTDS to begin processing. When GTDS has completed processing, it sends an intertask message to the copy task (GCOPY), which copies all screen-formatted reports to a report file. The copy task then sends the message that processing is complete to the message handler task (GIFMSG). The message handler displays a message on the bottom of the user's terminal (asynchronously from user input) and records it on the TCOPS Activities Log File (ALF). Note that all distribution to the ALF is provided through the GTDS control routines, not through GTDS itself. As intertask messages are received from GTDS by the message



NOTE: SHADED AREAS ARE PROVIDED BY APPLICATION.

Figure 3-1. Subtask Structure Used By Graphics Interface

display on the user's 5080 screen, they also are logged to the ALF by a call to the existing utility UTLOG. This ensures that only messages from critical mission support GTDS runs appear on the log file, and that routine daily batch GTDS runs and analysis and development GTDS runs do not write to the ALF (as they previously did not).

Also shown in Figure 3-1 is the Interjob Communication (IJC) subtask. This software is used to receive messages containing insertion vector element set numbers from a LAUNCH job, or to transmit messages containing GTDS-produced element set numbers or ephemeris file names to an Acquisition Data Generation (ADG) job. In all cases, control of the IJC is from the GUI; GTDS is never stopped or started automatically by another ID. Messages received from another job are displayed on the 5080 screen and the user may start GTDS using the indicated element set number from the TVHF. Similarly, when an element set number must be transmitted to ADG, the user enters the element set number on the screen, along with a transmission command.

Figure 3-2 depicts GTDS running under the TCOPS multitasking executive, along with an asynchronously running copy of the graphics package. This design approach enables GTDS to proceed with its required computations uninterrupted while the user is inspecting the results of current or previous processing on the graphics device. In addition, certain commands can be sent to GTDS to alter its processing mode. Both the control of GTDS and the inspection of the results of the processing can be performed from the same graphics device (a 5080 in the diagram). All of this can be provided within a single job space, thus conserving initiators.

Figure 3-3 shows an expanded diagram of the graphics package itself. The package control, plot, text display, and browse

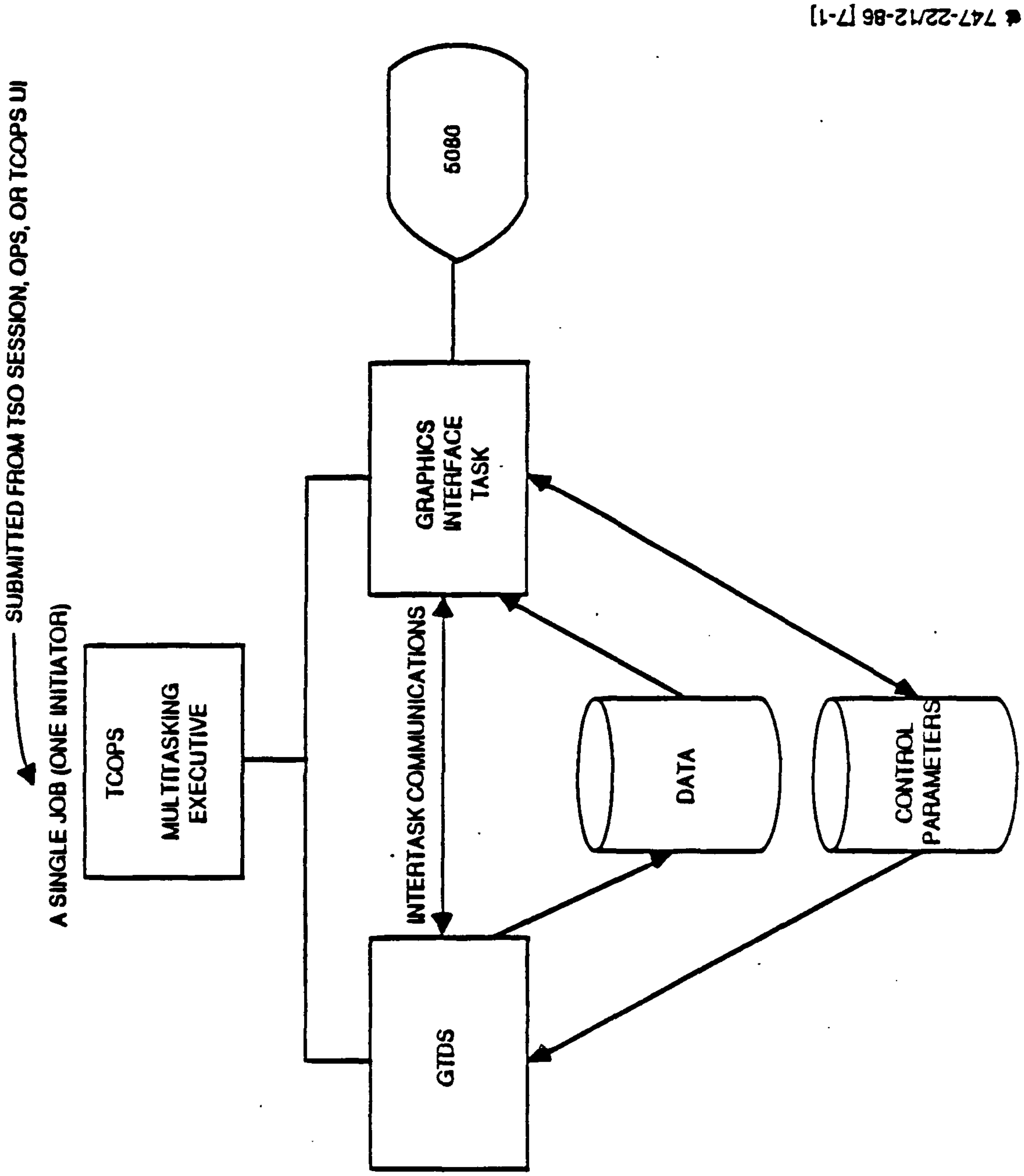


Figure 3-2. Use of TCOPS Graphics Package in a Subtasked Mode

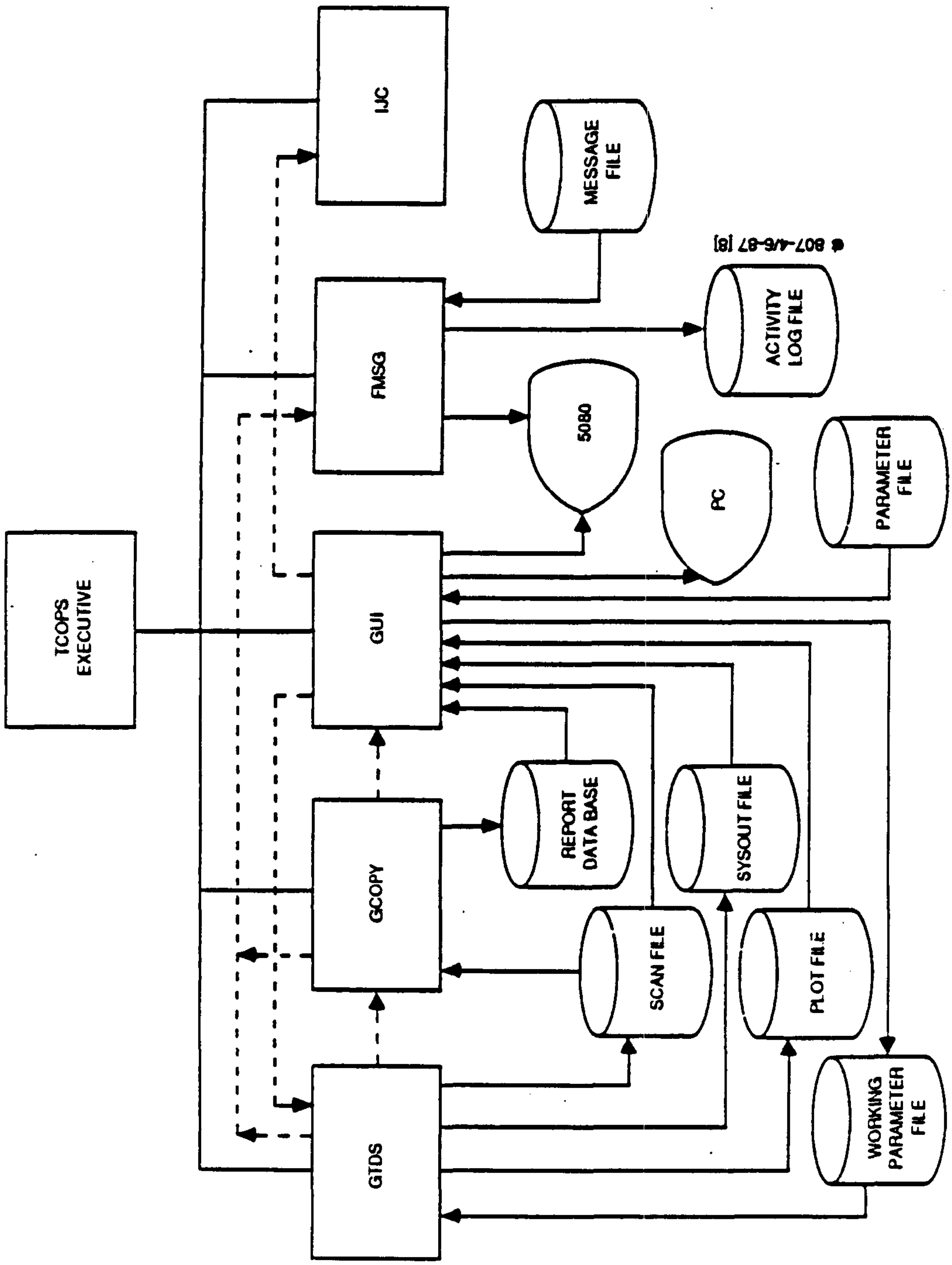


Figure 3-3. Graphics Interface Task

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components are standard with the package, but the user interface and control component are specific to GTDS. (Note that this code is not in GTDS, but in the graphics/control load module, except for a small amount of code required in GTDS to receive the commands issued by the graphics/control task.) The control available to the user from the graphics/control task will include setup and editing of GTDS keyword cards, identification of particular subdecks to be executed by GTDS, submission of these subdecks for execution (i.e., making them available to the GTDS task for processing), and inspection of plots and reports of data produced by GTDS.

3.11.1.2 Description of Processing in the GTDS GUI

3.11.1.2.1 Select Control Section

The GTDS control parameter file, defined in the JCL for the graphics job, contains one or more GTDS keyword card decks. These decks, or control sections, contain the parameters necessary to run the GTDS programs. When the Select GTDS Control Section option is chosen from the GTDS menu, the GUI software reads the control parameter file and displays a listing of all control cards included in the file. The user then can select one of these control sections for processing. This section is copied to the working parameter file, which maintains the last used control section. This working parameter file is the input file to GTDS.

At this point, the user can submit the selected section or modify it via one of the two methods discussed in the following paragraphs. The user may submit the section from the main GTDS menu option, or simply enter the command to submit from the control section selection panel.

The current contents of the working parameter file are indicated at the bottom of the list of control sections. If

the user exits this panel without selecting a control section, the contents of the working parameters file remain unchanged.

The user may replace the working parameters file at any time by selecting a new control section. Once selected, this control section is used until a new section is chosen. If a control section has been selected and modified, selecting it again will bring back the unmodified version.

3.11.1.2.2 Modify Key Parameters

After selecting a control section and before submitting it, the user can modify certain parameters via data entry panels. These data entry panels are shown in Section 3.11.1.3. The new values are validated and written out to the working parameters file for input to GTDS.

If the user selects to modify key parameters and no control section has been selected, the first control section on the control parameters file is copied to the working parameters file and used.

3.11.1.2.3 Edit Control Section

The selected control section can be edited directly by choosing the edit option. This allows the user to modify any parameters in the section, including those not available on the data entry panels. When the edit option is used, the parameters must be entered in standard GTDS keyword card format.

If the user chooses to edit the control section and no control section has been selected, the first control section on the control parameters file is copied to the working parameters file and used. The edited control section can be submitted from this panel.

3.11.1.2.4 Submit Control Section

The contents of the working parameters file can be submitted from the select control section, modify key parameters, or edit control section panels, as well as from the GTDS main menu. When the user submits the control section, an intertask message is sent to the GTDS load module to instruct it to begin processing the working parameters file. An advisory message is sent to the user's 5080 screen to confirm the submit request.

If the working parameters file is empty when the submit command is entered, the first control section on the control parameters file is copied to the working parameters file and used by GTDS.

If the mission support executive is brought up with a control section in the working parameters file, the user can submit this control section directly by entering the submit command. This provides a warm-start capability by resubmitting the last control section used in the event of a system failure during a GTDS run.

3.11.1.2.5 Cancel GTDS Run

The user can cancel an active GTDS run before it has completed by entering the cancel command. When this command is entered, an intertask message is sent to GTDS to stop processing. An advisory message is sent to the user's 5080 screen to confirm the cancel request.

During processing, GTDS periodically checks its message queues for a stop request. When this message is received, GTDS stops the run and returns to wait for the next request.

3.11.1.2.6 Bring Up GTDS Task

When the GTDS GUI is brought up, the GTDS task must be attached before submitting a GTDS run. When the GTUP option is selected, the executive brings up GTDS. After opening

all necessary files, GTDS goes into a wait state until a run is submitted (via the submit command). A message is sent by GTDS to the user and to the ALF when it is attached.

3.11.1.2.7 Bring Down GTDS Task

The user can have the GTDS task detached at any time by using the GDWN option on the GTDS main menu. When this option is selected, an intertask message is sent to GTDS to terminate.

If GTDS is running a program when the terminate message is received, the program is cancelled and GTDS terminates. The TCOPS executive then detaches the task. GTDS sends a message to the user and to the ALF immediately before terminating.

3.11.1.2.8 Automatic Residual Processing

The automatic residual processing option of the GUI allows the user to initiate automatic submission of GTDS residual computation runs. The residual processing is performed by the GTDS DC software. A GTDS input keyword file is prepared prior to submitting the graphics job and included in the GTDS control parameter file. The user selects this residual computation (O-C) control section via the usual select control section panel.

Default automatic residual processing run parameters are read in from a NAMELIST file (Table 3-3) and displayed on the automatic residual processing panel. The user then may modify these parameters and initiate processing by entering the submit command. The GUI then submits the working parameter file at the user-specified submit interval.

In addition to specifying the submit interval, the automatic residual processing panel allows the user to indicate the time period to be included in each run. The user can select for GTDS to begin each run at the same time, to begin each

Table 3-3. Automatic Residual Processing Parameters NAMELIST Input

Name: ARPPRM

Description: Automatic Residual Processing Default Parameters

Name	Type	Default	Description
GTSINT	R*8	5.0	GTDS submit internal (minutes)
GTNEDD	C*7		Nominal EPHEM ddname
GTSTIM	I*4	1	Start time selection 1 = Restart at original start time 2 = Continue from last stop time 3 = Delta time specified
GTDELT	R*8		Delta time for run
GTUPPL	I*4	0	Plot only if new data 0 = Yes 1 = No
GTSEPL	I*4	1	Selection of data type 1 = Default 2 = Manual selection
GTDTYP(2)	C*2	'RA','RR'	Data types for default selection

new run when the last run stopped, or to process the last x minutes of observations, where x is user supplied. If requested by the user, the start time will be updated at each run; the end time is always the end of data or current time.

The user may specify that a new plot is to be displayed only if new data has been processed, and the user needs to select the data to plot.

When selecting plots for automatic residual processing, the user has the option of requesting simply angle, range, or range-rate data. When this is done, the software will examine the residuals plot data file after each GTDS run and select the angle, etc. (as requested by the user) from the first batch to plot. This provides the capability to plot whatever tracking data is found in the file.

Alternatively, the user may select specific GTDS observation types. The user makes the selection after the first GTDS run; plotting of that observation type is then automatic after each subsequent GTDS run.

After submitting a GTDS run, the GUI waits for a completion message from GTDS, an interrupt from the user, or the time interval specified by the user. When a completion message is received from GTDS, the plot package is called to display the residuals. The GUI then continues to wait until it is time to submit the next GTDS run.

When the user-specified time has elapsed, if the previous GTDS run has completed, the GUI submits another run. If the previous run is not complete, the GUI will wait until it has received the completion message and read the plot data from that run before submitting another. This is necessary because GTDS will write over the plot output each time a run

is made. The plot is displayed after the next run is submitted so that the submit time is not delayed due to plotting.

When a user interrupts the automatic processing by pressing the appropriate function key, control of the GUI is returned to the user and automatic processing is stopped. The user then can change the autoprocessing parameters and restart, or use any other function of the GTDS GUI.

3.11.1.2.9 Send Data to Acquisition Data Task

During maneuver or postlaunch/postmaneuver support, GTDS may be used to compute a state vector or ephemeris to be used by the ADG task. The GTDS GUI informs ADG that a new vector/ ephemeris is available via an intertask message. The GADG entry panel allows the user to enter the necessary identification for the data (ddname of TVHF and element set number for a vector; ddname for an ephemeris file). This information then is formatted into an intertask message and sent to ADG. An advisory message is sent to the user's 5080 screen confirming that the intertask message was sent.

3.11.1.2.10 Display Reports

The reports provided by GTDS graphics mode (previously under GSP graphics) are available under the GUI. These reports are saved to a report file after each GTDS run by the GCOPY task. The reports generated in the latest run may be viewed under the browse reports option on the GTDS main menu. This option invokes the graphics package browse utility to display the requested report. Table 3-4 lists the GTDS reports available in this format. All saved reports can be browsed from the utilities menu using the report data base utilities described in Reference 16.

Table 3-4. Graphics Reports

- DC Program
  - Observation residuals report
  - Solve parameters report
  - Elements report
  - DC summary report
- EPHEM Program
  - Ephemeris report
  - Orbit generation summary report
- EPHEM Compare Program
  - Ephemeris differences report
  - Cartesian differences report
- EARLYORB Program
  - Observation residuals report
- All
  - Error Messages

3.11.1.2.11 Display Plots

GTDS writes data for plotting to output files, according to the program being run. The DC program produces data for a residuals plot and the EPHCMP program generates ephemeris differences plots, which can be displayed on the 5080.

The plot characteristics, such as color and line type, are input via a NAMELIST file during GUI initialization. Table 3-5 shows the contents of this NAMELIST file.

3.11.1.2.12 Browse Spooled Output

When run in batch mode, GTDS outputs a number of reports to the SYSOUT file in 132-column format. Under the GUI, this output is written to a cataloged data set that can be browsed at the 5080 terminal [or under Interactive System Productivity Facility (ISPF) on the 3278]. Under the GUI, the graphics package discussed in Reference 17 provides a 132-column format for the browse package for viewing these reports.

3.11.1.3 Detailed Description of GTDS GUI

To execute the GTDS GUI, the user must first logon to the FDF computers (NAS-AS8040 F1, F2, and F3) and, when prompted with READY, submit JCL that allocates the appropriate GTDS files for the particular run desired and the 5080 graphics terminal. The MSE menu (Figure 3-4) then will be displayed to the user. To enter the GTDS GUI, the user must select option 2 on the MSE menu. (The system must display AVAILABLE to be accessible.)

Once the user enters the GTDS GUI, the GTDS processing commands menu (Figure 3-5) is displayed. The user then may select a GTDS control section (a keyword card deck), modify key parameters of a control section, edit the entire control section, submit a control section, cancel a GTDS job

Table 3-5. Plot Parameters NAMELIST Input

Namelist: NTSET

Description: Plot Default Parameters

Name	Type	Default	Description
COL1	R*4	0	1st line color
COL2	R*4	0	2nd line color
COL3	R*4	0	3rd line color
STY1	C*4	'LNUL'	1st curve line style
STY2	C*4	'LNUL'	2nd curve line style
STY3	C*4	'LNUL'	3rd curve line style
WID1	R*4	1	Width of line for 1st curve
WID2	R*4	1	Width of line for 2nd curve
WID3	R*4	1	Width of line for 3rd curve
DM1	R*4	0	Brightness for 1st curve
DM2	R*4	0	Brightness for 2nd curve
DM3	R*4	0	Brightness for 3rd curve
GRIDC	R*4	0	Grid color

```
-------------- MSE  - MISSION SUPPORT EXECUTIVE MENU --------------------------
COMMAND ***> _

     1 ACMD - Acquisition Data Generation                   NOT AVAILABLE
     2 GCMD - Goddard Trajectory Determination System       AVAILABLE
     3 LCMD - Launch/Reentry                                NOT AVAILABLE
     4 BCMD - TDRSS Beam Angles                             NOT AVAILABLE
     5 UCMD - Utilities                                     AVAILABLE
     6 TERM - Terminate Mission Support Executive

Outstanding messages:  Critical    0 (  0%)  Non-critical    0 (  0%)
```

Figure 3-4. MSE Menu (1 of 2)

```
HELP ----------------- MISSION SUPPORT EXECUTIVE MENU ----------------- HELP
COMMAND ***> _

   Option  1 (ACMD) - This option allows the user to enter into the Aquisition
                      Data Generation (AQDATA) User Interface

   Option  2 (GCMD) - This option allows the user to enter into the Goddard
                      Trajectory Determination System (GTDS) User Interface

   Option  3 (LCMD) - This option allows the user to enter into the Launch
                      and Reentry User Interface

   Option  4 (BCMD) - This option allows the user to enter into the TDRSS Beam
                      Angle (TBA) User Interface

   Option  5 (UCMD) - This option allows the user to enter into the Utilities
                      User Interface

   Option  6 (TERM) - This option allows the user to terminate the Mission
                      Support Executive

Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-4. MSE Menu (2 of 2)

```
------------------ GTDS - GCMD - GTDS PROCESSING COMMANDS -------------------
COMMAND ===> _

  KEYWORD CARD SERVICES
    1 GCTL - Select GTDS Control Section
    2 GMOD - Modify Key Parameters
    3 GEDT - Edit Selected Control Section
    4 GSUB - Submit Control Section
    5 GCAN - Cancel GTDS Job Currently Running

  CONTROL SERVICES
    6 GTUP - Bring GTDS Up
    7 GDWN - Bring GTDS Down
    8 GARP - Set Up Automatic Residual Processing
    9 GADG - Send Data to ACQDATA Task

  VIEWING SERVICES
   10 GRPT - Browse Reports
   11 GEPL - Display Ephemeris Differences Plot
   12 GRPL - Display Residuals Plot
   13 GSPO - Browse Spooled Output

Press the END key to exit this menu

Outstanding messages   Critical   0 (  0%)   Non-critical   0 (  0%)
```

Figure 3-5. GTDS Processing Commands Menu (1 of 3)

```
HELP  --------------------  GTDS PROCESSING COMMANDS  --------------------  HELP
COMMAND ===> _

   Option  1 (GCTL) - This option allows the user to select a GTDS control
                      section from a list of available keyword card decks
                      The user may modify, edit, or submit the chosen keyword
                      card deck.

   Option  2 (GMOD) - This option allows the user to modify the key parameters
                      of the currently selected keyword card deck through a
                      data entry panel.  If a control section has not been
                      previously selected, the first keyword card deck in the
                      GTDS parameters file will be displayed.

   Option  3 (GEDT) - This option allows the user to edit the currently selected
                      keyword card deck in its entirety.  If a control section
                      has not been previously selected, the first keyword card
                      in the GTDS parameters file will be displayed.

   Option  4 (GSUB) - This option allows the user to submit the currently
                      selected keyword card deck, or if one has not been
                      selected, the first one in the GTDS parameters file
                      will be submitted.

   Option  5 (GCAN) - This option allows the user to cancel the GTDS job that
                      is currently running.

   Option  6 (GTUP) - This option allows the user to bring GTDS up through
                      the user interface.

   Option  7 (GDWN) - This option allows the user to bring GTDS down through
                      the user interface

   Option  8 (GARP) - This option allows the user to set up Automatic Residual
                      Processing by entering the necessary parameters on the
                      data entry panel that is displayed

   Option  9 (GADG) - This option allows the user to send data to the ACQDATA
                      task by entering the necessary parameters on the data
                      entry panel that is displayed

Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages  Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-5. GTDS Processing Commands Menu (2 of 3)

```
HELP --------------------- GTDS PROCESSING COMMANDS -------------------- HELP
COMMAND ===> _

   Option 10 (GRPT) - This option allows the user to browse reports that are
                      generated as the result of the control section that was
                      submitted

   Option 11 (GEPL) - This option allows the user to display the Ephemeris
                      Differences Plot by entering the necessary parameters
                      on the data entry panel that is displayed

   Option 12 (GRPL) - This option allows the user to display the Residuals
                      Plot by entering the necessary parameters on the data
                      entry panel that is displayed

   Option 13 (GSPO) - This option allows the user to browse the spooled output
                      generated by the GTDS job that was submitted

Commands
 ENTER = Next Page (exit if last)        DOWN = Next Page (if any)
 END   = Exit This Help Display          UP   = Previous Page (if any)

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-5. GTDS Processing Commands Menu (3 of 3)

that is running, bring GTDS up or down, set up automatic residual processing, send data to the ADG task, browse reports, display plots, or browse spooled output.

If the user wishes to exit this menu, the user must type "END" on the command line or press the "END" function key on the function key pad attached to the 5080 graphics terminal (Figure 3-6). The user will return to the MSE menu.

As an alternative method for exiting the GTDS GUI, the user may type "=6" or "=CCMD" as a jump command from any menu or data entry panel.

NOTE: Once the user becomes familiar with all of the four-letter commands listed on each of the five subsystems' main menus in the GUI, the user may specify the appropriate jump command to go directly to the menu or data entry panel he or she desires instead of going through the hierarchical structure of the GUI. In addition, the function key pad has function keys for all of the subsystems' main menus; thus, the user may enter any subsystem (provided it is available) by pressing the appropriate function key.

Each menu and data entry panel has a corresponding help panel associated with it. To view the help panel, the user must either enter "HELP" on the command line or press the "HELP" function key.

3.11.1.3.1 Select Control Section

If the user chooses option 1 on the GTDS processing commands menu, the select control section menu is displayed (Figure 3-7). This menu displays the control card for each keyword card deck that is contained in the GTDS control parameters file, defined in the JCL. The user must enter an "S" beside the control section he or she wishes to modify, edit, or submit.

If the user wishes to modify or edit a control section, he or she must enter the command "EXEC" or press the appropriate

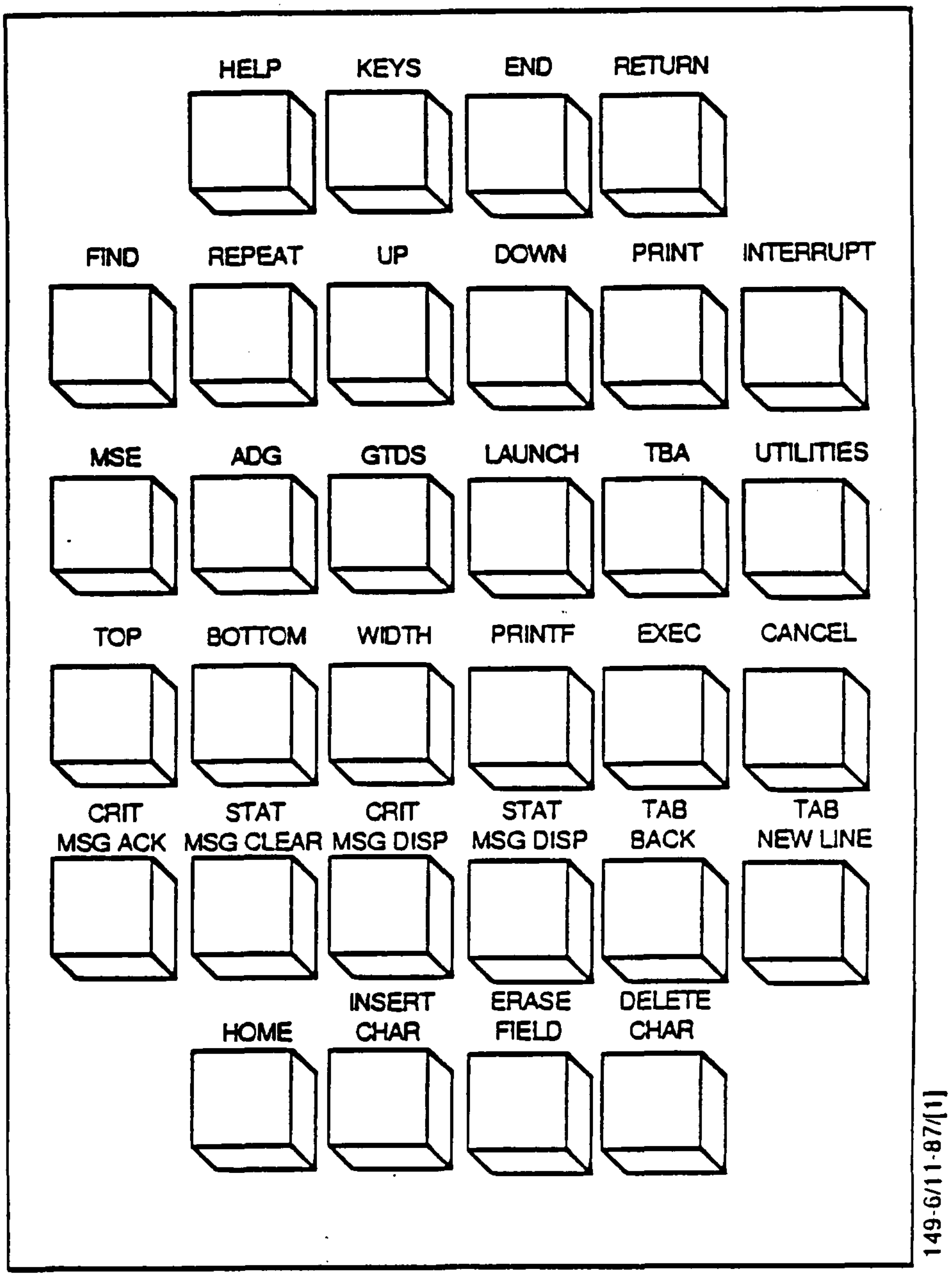

Figure 3-6. Function Key Pad

```
----------------- GTDS - GCTL - SELECT CONTROL SECTION MENU -----------------
COMMAND ===> _

 Enter an 'S' before the control section to be modified, edited, or submitted

                CONTROL                    SATELLITE     SATELLITE
                SECTION                       ID          ACRONYM

      1  CONTROL   EPHEM                   8302602       TDRS-1
      2  CONTROL   DC                      7502701       GEOS-3
      3  CONTROL   COMPARE                 1234567       ERTS
      4  CONTROL   EARLYORB                7503301       ABCD

 Currently selected control section is number    3   Modified   YES

Commands
 EXEC    = Save Input
 SUB     = Submit GTDS Run
 CANCEL  = Exit Panel Without Action

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-7. GTDS Select Control Section Menu (1 of 2)

```
HELP ------------------ SELECT CONTROL SECTION MENU ------------------ HELP
COMMAND ===> _

  This menu displays all the GTDS control sections that appear in the GTDS
  parameters file.  The user may select a control section to modify, edit,
  or submit.  The OC and OC TDRSS parameters, the Orbit Propagator parameters,
  the Ephem Compare parameters, and the Early Orbit parameters are the only
  keyword card decks that can be modified through data entry panels.  These
  data entry panels contain only the key parameters for each deck.  However,
  each keyword deck that is contained in the GTDS parameters file may be
  edited in its entirety by selecting option 3 (GEDT) from the GTDS Main
  Menu.

Commands:
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)
Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-7. GTDS Select Control Section Menu (2 of 2)

function key. If the user wishes to submit the chosen control section, he or she must enter the command "SUB." (There is no function key equivalent for the command "SUB.")

The line of text directly below the control cards indicates which control section was selected and if it was modified.

The user will exit this menu when any of the three commands "EXEC," "SUB," or "CANCEL" are entered and return to the GTDS processing commands menu.

3.11.1.3.2 Modify Key Parameters

If the user selects option 2 on the GTDS processing commands menu, a data entry panel is displayed containing the key parameters of the selected control section (Figures 3-8 through 3-11). For example, if the user selects the EPHEM control section on the select control section menu, the modify orbit propagator parameters panel will be displayed when the user selects the modify key parameters option from the GTDS processing commands menu. Only four control sections may be modified via these data entry panels. These include the EPHEM, DC, COMPARE, and EARLYORB control sections. However, all of the control sections may be modified in their entirety by selecting option 3 from the GTDS menu.

If the user does not select a control section from the select control section menu prior to selecting this option, the key parameters of the first control section found in the GTDS control parameters file will be displayed.

If the user wishes to edit and save the key parameters without submitting the control section, he or she must enter the command "EXEC" or press the appropriate function key. To submit the control section, the user must enter the command "SUB." To exit the panel without saving any changes made or submitting the control section, the user must enter the

```
-------------  GTDS - GPGT - MODIFY ORBIT PROPAGATOR PARAMETERS  --------------
COMMAND ===> _

Satellite Id                   => 8302602                (NNNNNNN)
Satellite Acronym              => TDRS-1                 (AAAAAAAA)
Orbit Propagator Type          => 02                     (1 - 14)
Integrator Stepsize            => 0600                   (NNNN Seconds)
Output Stepsize                => 1200                   (NNNN Seconds)
End Time of Ephem Output       => 86/111/19:00:00.000    (YY/DDD/HH:MM:SS.SSS)
Generate Ephem File            => Y                      (Y/N)
  If Yes - Ephem File
           DDName              => EPHEM1                 (AAAAAAA)

TCOPS Vector Hold File
  DDName                       =>                        (AAAAAAA)
  Element Set Number           => 0000                   (NNNN)
  OR
Epoch                          => 86/110/00:00:00.000    (YY/DDD/HH:MM:SS.SSS)
Cartesian Position - X         => -0 410386483140E+05    (Up to 12 digits Km)
                     Y         =>  0 969920303231E+04    (Up to 12 digits Km)
                     Z         =>  0 673493012164E+03    (Up to 12 digits Km)
Cartesian Velocity - Xdot      => -0 707898513206E+00    (Up to 12 digits Km/Sec)
                     Ydot      => -0 299136843901E+01    (Up to 12 digits Km/Sec)
                     Zdot      => -0 184746838820E-01    (Up to 12 digits Km/Sec)
Reference Coordinate
  System                       => 1950                   (1950 or TOD-True of Date)
Central Body                   => EARTH                  (AAAAAAA)

Optional Satellite Parameters.
  Solar Radiation
    Coefficient
    (C Sub R)                  =>  0 142698170000E+01    (Up to 12 digits)
  Drag Coefficient
    (C Sub D2)                 =>  0 000000000000E+00    (Up to 12 digits)
  Mass                         =>  0 176400000000E+04    (Up to 12 digits Kg)
  Cross Sectional Area         =>  0 400000000000E-04    (Up to 12 digits Km**2)


Commands
 EXEC   = Save Input
 SUB    = Submit GTDS Run
 CANCEL = Exit Panel Without Action

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-8. Modify Orbit Propagator Parameters (1 of 2)

```
HELP  ------------  MODIFY GTDS ORBIT PROPAGATOR PARAMETERS  -------------  HELP
COMMAND ===> _

   The key parameters on the Orbit Propagator parameters panel come from the
   following keyword cards:

          Satellite ID                   => CONTROL
          Satellite Acronym              => CONTROL
          Orbit Propagator Type          => ORBTYP
          Integrator Stepsize            => ORBTYP
          Output Stepsize                => OUTPUT
          End Time of Ephem Output       => OUTPUT
          Generate Ephem File            => OUTOPT
          Ephem File DDName              => Input on the panel by the user
          TCOPS Vector Hold              => Input on the panel by the user
            File DDName
          Element Set Number             => WORKELS
          Epoch                          => EPOCH
          Cartesian Position - X         => ELEMENT1
          Cartesian Position - Y         => ELEMENT1
          Cartesian Position - Z         => ELEMENT1
          Cartesian Velocity - Xdot      => ELEMENT2
          Cartesian Velocity - Ydot      => ELEMENT2
          Cartesian Velocity - Zdot      => ELEMENT2
          Reference Coordinate           => ELEMENT1
            System
          Central Body                   => ELEMENT1
          Solar Reflectivity             => SOLRDPAR
            Coefficient
          Drag Coefficient               => DRAGPAR
          Mass                           => SCPARAM
          Cross Sectional Area           => SCPARAM

Commands
<ENTER> = Next Page (exit if last)      DOWN = Next Page (if any)
 END    = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages:  Critical     0 (  0%)   Non-critical     0 (  0%)
```

Figure 3-8. Modify Orbit Propagator Parameters (2 of 2)

```
---------------- GTDS - GDCP - MODIFY DC PARAMETERS (1 of 2) ----------------
COMMAND ===> _

  Satellite Id                   =: 7502701                (NNNNNNN)
  Satellite Acronym              =: GEOS-3                 (========)

  TCOPS Vector Hold File
    DDName                       =:                        (========)
    Element Set Number           =: 0000                   (NNNN)
    OR
  Epoch                          =: 79/060/10 00 00 000    (YY/DDD/HH MM SS SSS)
  Cartesian Position - X         => 0.4975836618357E+04    (Up to 12 digits km)
                       Y         =: -0.4255207503?4E+04    (Up to 12 digits km)
                       Z         =: -0.3045446682?65E+04   (Up to 12 digits km)
  Cartesian Velocity - Xdot      =: -0.4356056803?4E+01    (Up to 12 digits km/sec)
                       Ydot      =: -0.5197892??198E+00    (Up to 12 digits km/sec)
                       Zdot      =: -0.5056294296?1E+01    (Up to 12 digits km/sec)
  Reference Coordinate
    System                       =: TOD                    (1950 or TOD-True of Date)
  Central Body                   =: EARTH                  (========)

  Start Time                     =: 79/058/00 00 00 000    (YY/DDD/HH MM SS SSS)
  End Time                       =: 79/062/00 00 00 000    (YY/DDD/HH MM SS SSS)
  Orbit Propagator Type          =: 02                     (1 - 14)
  TDRSS Run                      =: Y                      (Y/N)
  Optional Satellite Parameters
    Solar Reflectivity
     Coefficient
     (C Sub R)                   =: 0.0000000000000E+00    (Up to 12 digits)
    Drag Coefficient
     (C Sub DZ)                  => 0.0000000000000E+00    (Up to 12 digits)
    Mass                         => 0.3365600000000E+03    (Up to 12 digits kg)
    Cross Sectional Area         => 0.1400000000000E-05    (Up to 12 digits km**2)

Commands
 DOWN   - Display TDRSS Parameters (Only if TDRSS run specified)
 EXEC   - Save Input
 SUB    - Submit GTDS Run
 CANCEL - Exit Panel Without Action

Outstanding messages   Critical   0 (  0%)   Non-critical   0 (  0%)
```

Figure 3-9. Modify DC Parameters (1 of 4)

```
HELP  -----------------  MODIFY DC PARAMETERS (1 of 2)  -----------------  HELP
COMMAND ===> _

   The key parameters on the Modify DC Parameters (1 of 2) panel come from the
   following keyword cards.

         Satellite ID                  => CONTROL
         Satellite Acronym             => CONTROL
         TCOPS Vector Hold             => Input on the panel by the user
           File DDName
         Element Set Number            => WORKELS
         Epoch                         => EPOCH
         Cartesian Position - X        => ELEMENT1
         Cartesian Position - Y        => ELEMENT1
         Cartesian Position - Z        => ELEMENT1
         Cartesian Velocity - Xdot     => ELEMENT2
         Cartesian Velocity - Ydot     => ELEMENT2
         Cartesian Velocity - Zdot     => ELEMENT2
         Reference Coordinate          => ELEMENT1
           System
         Central Body                  => ELEMENT1
         Start Time                    => OBSINPUT
         End Time                      => OBSINPUT
         Orbit Propagator Type         => ORBTYPE or if TDRSS run - TDRORB
         TDRSS Run                     => Protected field - set by software
         Solar Reflectivity            => SOLRDPAR or if TDRSS run - TDRREFLC
           Coefficient
         Drag Coefficient              => DRAGPAR
         Mass                          => SCPARAM or if TDRSS run - TDRSCPRM
         Cross Sectional Area          => SCPARAM or if TDRSS run - TDRSCPRM


Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-9. Modify DC Parameters (2 of 4)

```
----------------  GTDS - GDCP - MODIFY DC PARAMETERS (3 of 4)  ----------------
COMMAND ===> _

 TDRS 1 Satellite Id                 =  7990101                (NNNNNNNN)
 TCOPS Vector Hold File DDName  =:                           'AAAAAAAA'
   Element Set Number                =: 0000                   (NNNN)
     OR
 PTOF Level Number                   =: 0000                   (NNNN)
     OR
 Epoch                               =: 79/059/00 00 00 000    (YY/DDD/HH MM SS SSS)
 Cartesian X => 0.421680000000E+05    Cartesian Xdot =  0.900000000000E+[illegible]
  Position Y => 0.500000000000E-03     Velocity Ydot =  0.240000000000E+03
     (Km)  Z => 0.750000000000E+00     (Km/Sec) Zdot =  0.1621[illegible]E+[illegible]

 TDRS 2 Satellite Id                 =: 7990301                (NNNNNNNN)
 TCOPS Vector Hold File DDName  =:                           'AAAAAAAA'
   Element Set Number                =: 0000                   (NNNN)
     OR
 PTOF Level Number                   =: 0000                   (NNNN)
     OR
 Epoch                               =: 79/059/00 00 00 000    (YY/DDD/HH MM SS SSS)
 Cartesian X => 0.421660000000E+05    Cartesian Xdot =  0.190000000000E+03
  Position Y => 0.100000000000E-04     Velocity Ydot =  0.000000000000E+00
     (Km)  Z => 0.500000000000E-01     (Km/Sec) Zdot =  0.[illegible]E+[illegible]

 TDRS 3 Satellite Id                 =  [illegible]99[illegible]01    (NNNNNNNN)
 TCOPS Vector Hold File DDName  =:                           'AAAAAAAA'
   Element Set Number                =: 0000                   (NNNN)
     OR
 PTOF Level Number                   =: 0000                   (NNNN)
     OR
 Epoch                               =  [illegible]           ([illegible] DDD [illegible])
 Cartesian X => 0.421640000000E+05    Cartesian Xdot =  [illegible]
  Position Y => 0.100000000000E-[illegible]  Velocity Ydot =  [illegible]
     (Km)  Z => 0.125000000000E-[illegible]  (Km/Sec) Zdot =  [illegible]

Commands
 UP     = Display Previous DC Panel
 EXEC   = Save Input
 SUB    = Submit GTDS Run
 CANCEL = Exit Panel Without Action

Outstanding messages  Critical   0 (  0%)   Non-critical   0 (  0%)
```

Figure 3-9. Modify DC Parameters (3 of 4)

```
HELP ----------------- MODIFY DC PARAMETERS (2 of 2) ----------------- HELP
COMMAND ===> _

  If the TDRSS Run field from the Modify DC Parameters (1 of 2) panel is set
  to 'YES', then the Modify DC Parameters (2 of 2) panel is displayed when the
  user chooses the 'EXEC' or 'SUB' command.  This panel contains the TDRSS
  parameters for the three TDRS'.

  The key parameters on the Modify DC Parameters (2 of 2) panel come from the
  following keyword cards

         TDRS Satellite Id                 => TDRID
         TCOPS Vector Hold File DDName =>  Input on the panel by the user
           (Note   The DDName input here should be the same that was
                   input on the Modify DC Parameters (1 of 2) panel)

         Element Set Number                => TDRUKELS
         PTOF Level Number                 => TDRORB
         Epoch                             => TDREPOCH
         Cartesian Position - X            => TDRELEM1
         Cartesian Position - Y            => TDRELEM1
         Cartesian Position - Z            => TDRELEM1
         Cartesian Velocity - Xdot         => TDRELEM2
         Cartesian Velocity - Ydot         => TDRELEM2
         Cartesian Velocity - Zdot         => TDRELEM2

Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-9. Modify DC Parameters (4 of 4)

```
---------------  GTDS - GECP - MODIFY EPHEM COMPARE PARAMETERS  ---------------
COMMAND ===> _

 Ephem File 1 DDName       => EPHEM1                  (AAAAAAA)
 Ephem File 2 DDName       => EPHEM2                  (AAAAAAA)
 Type of Comparison        => 1                       (1 = Position
                                                       2 = Position & Velocity
                                                       3 = Lat/Long/Height)
 Comparison Technique      => 3                       (1 = Matched times.
                                                       2 = Constant stepsize.
                                                       3 = Interpolated times)
 Comparison Start Time => 79/224/23 00:00 000         (YY/DDD/HH:MM:SS SSS)
 Comparison End Time   => 79/225/01:00:00 000         (YY/DDD/HH:MM:SS SSS)
 Comparison Interval   => 60                          (NNNN Seconds)
 Printer Plots         => Y                           (Y/N)
   If yes, Plot Type   => 03                          (1 = Track-oriented pos diff.
                                                       2 = Track-oriented vel diff.
                                                       4 = Cartesian position diff.
                                                       8 = Cartesian velocity diff.
                                                       Any combination of plots
                                                       obtained by entering sum
                                                       of desired codes)
      Minimum Y Value => -0 200000000000E+03          (Up to 12 digits)
      Maximum Y Value =>  0 200000000000E+03          (Up to 12 digits)
      Units           => K                            (K = Kilometers.
                                                       M = Meters.
                                                       C = Centimeters)

Commands
 EXEC   = Save Input
 SUB    = Submit GTDS Run
 CANCEL = Exit Panel Without Action
Outstanding messages  Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-10. Modify EPHEM Compare Parameters (1 of 2)

```
HELP  -----------------  MODIFY EPHEM COMPARE PARAMETERS  ----------------  HELP
COMMAND ===> _

   The key parameters on the Ephem Compare Parameters panel come from the
   following keyword cards:

          Ephem File 1 DDName.      => Input on the panel by the user
          Ephem File 2 DDName       => Input on the panel by the user
          Type of Comparison        => CMPEPHEM
          Comparison Technique      => CMPFILES
          Comparison Start Time     => CMPEPHEM
          Comparison End Time       => CMPEPHEM
          Comparison Interval       => CMPEPHEM
          Printer Plots             => Input on the panel by the user
          Plot Type                 => CMPPLOT
          Minimum Y Value           => CMPPLOT
          Maximum Y Value           => CMPPLOT
          Units                     => CMPPLOT








Commands
 ENTER = Next Page (exit if last)       DOWN = Next Page (if any)
 END   = Exit This Help Display         UP   = Previous Page (if any)

Out Pending messages   Critical     0 (  0%)   Non-critical     0 (  0%)
```

Figure 3-10. Modify EPHEM Compare Parameters (2 of 2)

```
----------------  GTDS - GEOP - MODIFY EARLY ORBIT PARAMETERS  ---- -- - -
COMMAND ===> _

Satellite Id                         => [illegible]                 (NNNNNNN)
Satellite Acronym                    => [illegible]                 (AAAAAAAA)
Start Time                           => 75/287/14 00 00 000         (YY/DDD/HH MM SS SSS)
End Time                             => 75/287/16 00 00 000         (YY/DDD/HH MM SS SSS)
Epoch                                => 75/287/14 00 00 000         (YY/DDD/HH MM SS SSS)
Early Orbit
  Determination Method               => 4                           (1 = Automatic,
                                                                     2 = Range and Angles
                                                                     3 = Gauss
                                                                     4 = Double-R)

For Range-Angles and Gauss.
  Estimate of Semimajor Axis         => [illegible]                 (Up to 12 digits Km

For Double-R Iteration:
  Direction of Orbital Motion        => [illegible]                 (+1 = Direct
                                                                      0 = Determined
                                                                          by software,
                                                                     -1 = Retrograde)

  Perform Preliminary Orbit Search:
                                     => N                           (Y/N)
   . If Yes - Spacecraft Height
       at 2nd Observation            => [illegible]                 (Up to 12 digits Km)
     If No - Estimate of
       Geocentric Distance at
          1st Observaton             => [illegible]                 (Up to 12 digits Km)
       Estimate of Geocentric
          Distance at 2nd
          Observation                => [illegible]E+04             (Up to 12 digits Km)




Commands.
 EXEC    = Save Input
 SUB     = Submit GTDS Run
 CANCEL  = Exit Panel Without Action

Outstanding messages:  Critical     0 (  0%)    Non-critical     0 (  0%)
```

Figure 3-11. Modify Early Orbit Parameters (1 of 2)

```
HELP ----------------- MODIFY EARLY ORBIT PARAMETERS ----------------- HELP
COMMAND ===> _

   The key parameters on the Modify Early Orbit Parameters panel come from the
   following keyword cards:

           Satellite ID                            => CONTROL
           Satellite Acronym                       => CONTROL
           Start Time                              => OBSINPUT
           End Time                                => OBSINPUT
           Epoch                                   => EPOCH
           Early Orbit Determination               => TYPE
             Method
           Estimate of Semimajor Axis              => TYPE
           Direction of Orbital Motion             => TYPE
           Perform Preliminary Orbit               => PRESERCH
             Search
           Spacecraft Height at 2ND                => PRESERCH
             Observation
           Estimate of Geocentric Distance         => TYPE
             at 1ST Observation
           Estimate of Geocentric Distance         => TYPE
             at 2ND Observation

Commands
 ENTER = Next Page (exit if last)       DOWN = Next Page (if any)
 END   = Exit This Help Display         UP   = Previous Page (if any)

Outstanding messages   Critical     0 (   0%)   Non-critical     0 (   0%)
```

Figure 3-11. Modify Early Orbit Parameters (2 of 2)

command "CANCEL" or press the appropriate function key. Since the user is able to modify only the key parameters of the control section with this option, he or she must be aware of the other parameters contained in the keyword card deck when submitting the control section.

All three commands "EXEC," "SUB," and "CANCEL," when entered, will return the user back to the GTDS processing commands menu.

3.11.1.3.3 Edit Selected Control Section

If the user chooses option 3 on the GTDS processing commands menu, the edit selected control section panel is displayed (Figure 3-12). This panel displays the entire control section as it is found in the GTDS control parameters file.

The user may insert a line, delete a line, or make temporary changes to the control section. To insert a line, the user must type an asterisk in the first column of the line to be moved down and enter the command "INS." The user then may type in the new keyword card. To delete a line, the user must type an asterisk in the first column of the line to be deleted and enter the command "DEL." The keyword card then is removed from the control section. If the user wishes to make temporary changes until the commands "EXEC" or "SUB" are entered, he or she must enter the command "CNG."

To save the changes made without submitting the control section, the user must enter the command "EXEC" or press the appropriate function key. If the user chooses to submit the edited control section, he or she must enter the command "SUB." To exit the panel without saving changes or submitting the control section, the user must enter the command "CANCEL" or press the appropriate function key.

```
----------------- GTDS - GEDT - EDIT SELECTED CONTROL SECTION ----------------
COMMAND ***> _

Col:
1-------9--12-15-18--------------------39--------------------60-------------------
|       |  |  |  |                     |                     |

CONTROL   EPHEM                                              TDRS-1      8302602
EPOCH     0   0   0 0 860420000000000D+06 0.000000000000000D+00 0.000000000000000D+00
ELEMENT1  1   1   1-0 41038648314022D+05 0.96992030323071D+04 0.67349301216435D+03
ELEMENT2  0   0   0-0 70789851320636D+00-0.29913684390147D+01-0 18474683882007D-01
ORBTYPE   2   1   1 0 600000000000000D+03 0.000000000000000D+00 0.000000000000000D+00
OUTPUT    2   1   1 0 86042100000000D+06 0 100000000000000D+06 0.120000000000000D+04
OGOPT     0   0   0 0 000000000000000D+00 0.000000000000000D+00 0.000000000000000D+00
OUTOPT    3   2   2 0 86042000000000D+12 0 86042110000000D+12 0.000000000000000D+00
MAXDEGEQ  1   0   0 0 500000000000000D+01 0 000000000000000D+00 0 000000000000000D+00
MAXORDEQ  1   0   0 0 500000000000000D+01 0 000000000000000D+00 0 000000000000000D+00
MAXORDVE  1   0   0 0 400000000000000D+01 0 000000000000000D+00 0 000000000000000D+00
MAXDEGVE  1   0   0 0 400000000000000D+01 0 000000000000000D+00 0 000000000000000D+00
SOLRAD    1   0   0 0 100000000000000D+01 0 000000000000000D+00 0 000000000000000D+00
SOLRDPAR  2   0   0 0 14269817000000D+01 0 000000000000000D+00 0 000000000000000D+00
SCPARAM   0   0   0 0 400000000000000D-04 0 176400000000000D+04 0 000000000000000D+00
END       0   0   0 0 000000000000000D+00 0 000000000000000D+00 0 000000000000000D+00
FIN       0   0   0 0 000000000000000D+00 0 000000000000000D+00 0 000000000000000D+00




|       |  |  |  |                     |                     |
1-------9--12-15-18--------------------39--------------------60-------------------
Commands
 EXEC    = Save Input
 SUB     = Submit GTDS Run
 CANCEL  = Exit Panel Without Action
 INS     = Insert Line (type - in column 1 of line to be moved down)
 DEL     = Delete Line (type - in column 1 of line to be deleted)
 CNG     = Enter Changes

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-12. Edit Selected Control Section (1 of 2)

```
HELP -----------------  EDIT SELECTED CONTROL SECTION  -----------------  HELP
COMMAND ===> _

        The GTOS Editor provides a method of modifying any parameter
        in a keyword card deck.  For modification of commonly changed
        parameters, the MODIFY KEY PARAMETERS option provides entry
        panels (GM100).  This editor has the capability of inserting
        and deleting lines, changing lines, and inserting and deleting
        characters.  The EXEC command saves the modified control section
        to the working parameters file.  The SUB command writes the
        the modified control section to the working parameters file and
        submits a GTOS run.  The CANCEL command cancels any changes
        made since the last EXEC or SUB.

        To INSERT a line, place an asterisk in the first column of the
        line to be moved down to make room for the insert line.  Then
        enter the command INS at the command line.  The screen will be
        redisplayed with a blank line.  You may then enter the new line.
        To save the new line internally, only enter CHG on the command
        line.  The change is then saved temporarily until an EXEC, SUB
        or CANCEL command is entered.

        To DELETE a line, place an asterisk in the first column of the
        line to be deleted and enter DEL on the command line.  The
        screen will be redisplayed with the indicated deleted.

        The CHANGE command (CHG) can be entered at any time to
        temporarily save changes to the display.  Changes are then
        saved until an EXEC, SUB, or CANCEL command is entered.

Commands
<ENTER>= Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages:  Critical  [illegible]   Non-critical  [illegible]
```

Figure 3-12. Edit Selected Control Section (2 of 2)

The user will exit this panel when the command "EXEC," "SUB," or "CANCEL" is entered and return to the GTDS processing commands menu.

3.11.1.3.4 Submit Control Section

When the user selects option 4 on the GTDS processing commands menu, the control section selected from the select control section menu is submitted to GTDS for processing. If a control section was not previously selected, the first control section found in the GTDS control parameters file is submitted to GTDS for processing.

Before a control section can be submitted for processing, GTDS must be brought up. This is done by selecting option 6 on the GTDS processing commands menu.

3.11.1.3.5 Cancel GTDS Run

When the user chooses option 5 on the GTDS processing commands menu, a message is sent to GTDS to cancel the control section that was submitted for processing.

3.11.1.3.6 Bring GTDS Up

If the user selects option 6 on the GTDS processing commands menu, the GTDS task is attached. This must be done before submitting a control section.

3.11.1.3.7 Bring GTDS Down

If the user chooses option 7 on the GTDS processing commands menu, the GTDS task is detached. If a GTDS job is running when this option is selected, the GTDS run is cancelled and GTDS is then detached.

3.11.1.3.8 Automatic Residual Processing

If the user selects option 8 on the GTDS processing commands menu, the automatic residual processing parameters panel is displayed (Figure 3-13). The first line of information

```
---------- GTDS - GARP - AUTOMATIC RESIDUAL PROCESSING PARAMETERS ------------
COMMAND ===> _

CONTROL   EPHEM                                                TDRS-1     8302602

 GTDS Submission Interval      => 5 00       (NN.NN Minutes)
 Nominal Ephem DDName          => EPHEM1     (AAAAAAA or blank if vector has
                                              been specified on keyword card)
 Start Time Selection          => R          (R = Restart from original start time.
                                              C = Continue from last stop time.
                                              D = Delta time specified)
   If D, enter Delta Time      => 0 00       (NN.NN Minutes)
Residual Plot Parameters
  Plot Only if New Data        => N          (Y/N)
  Selection of Data Type       => D          (D = Default.
                                              M = Manual)
     If D. enter Data Types    => RA         (Enter up to 2 types
                               => RR          RA = Range.
                                              RR = Range Rate/Doppler.
                                              A1 = First Angle.
                                              A2 = Second Angle)

Commands
 EXEC   = Save Input
 SUB    = Submit GTDS Run
 CANCEL = Exit Panel Without Action

Outstanding messages   Critical     0 (  0%)   Non-critical     0 (  0%)
```

Figure 3-13. Automatic Residual Processing Parameters (1 of 3)

```
HELP ------------ AUTOMATIC RESIDUAL PROCESSING PARAMETERS ------------ HELP
COMMAND ===> _

         Automatic Residual Processing submits GTDS O-C runs at
         user indicated time intervals. Processing is halted by
         pressing the automatic interrupt function key

         The parameters which can be specified are as follows

         GTDS Submission Interval -
              The time interval at which subsequent GTDS O-C runs
              are to be submitted, in minutes

         Nominal Ephem DDName -
              The ddname of the nominal ephemeris to be used in
              in determining the computed observation values, if
              one is to be used  If a start vector is specified
              in the keyword card deck, this field should be left
              blank

         Start Time Selection
              R (Restart) - Each GTDS run will start at the same
                            start time. End time is the current
                            time when the job is submitted.
              C (Continue)- Each GTDS run will start at the time
                            the previous run ended  The first
                            start time is the time on the keyword
                            file when ARP is begun. End time is
                            always the time when the run is submitted
              D (Delta t) - The end time is the time when the run is
                            submitted. The start time is N minutes
                            before the end time, where N is the
                            Delta Time entered in the next field of the
                            panel.

         Plot only if New Data -
              A new plot will be generated and displayed only if the
              GTDS run has found data beyond the end of the previous
              run if this field is 'Y'   If 'N' is entered, a new plot
              is displayed after each run

Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-13. Automatic Residual Processing Parameters (2 of 3)

```
HELP  ------------  AUTOMATIC RESIDUAL PROCESSING PARAMETERS  ------------  HELP
COMMAND ===> _

        Selection of Data Type
          D (Default)  - The data types described by the next field
                         will be plotted after each run.  The
                         data available in the residuals plot data
                         file is scanned and the first type which
                         matches the user input is selected to plot
          M (Manual)   - After the first GTDS run, a list of
                         available data types is displayed on the
                         screen.  The user may then select the
                         specific data (batch and type) to be plotted
                         The same data type and batch will then be
                         plotted after each GTDS run
          Data Types   - For Default data selection, the user enters
                         the category of data to be plotted.  The
                         options are range (RA), range-rate or doppler
                         (RR), and one or two angles (A1 and A2)
                         Up to 2 categories may be selected

Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)
Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-13. Automatic Residual Processing Parameters (3 of 3)

displays the control card of the currently selected control section; this cannot be modified.

The user may save changes without submitting the control section by entering the "EXEC" command or pressing the appropriate function key. If the user chooses to submit the control section, he or she must enter the "SUB" command. To exit the panel without saving changes or submitting the control section, the user must enter the "CANCEL" command or press the appropriate function key.

The user will exit this panel when the command "EXEC," "SUB," or "CANCEL" is entered and return to the GTDS processing commands menu.

3.11.1.3.9 Send Data to Acquisition Data Task

If the user selects option 9 on the GTDS processing commands menu, the send data to ACQDATA task panel is displayed (Figure 3-14).

To send a message to the ACQDATA task, the user must enter the command "EXEC." If the user wishes to exit this panel without sending a message to the ACQDATA task, he or she must enter the "CANCEL" command. Either command will exit the panel and return the user to the GTDS processing commands menu.

3.11.1.3.10 Browse Reports

If the user chooses option 10 on the GTDS processing commands menu, the browse reports menu is displayed (Figure 3-15). The reports listed on the menu depend on the control section that was selected. For example, if the user selects the EPHEM control section on the select control section menu, the EPHEM report titles will be displayed. The user then may select a report to browse by entering an "S" beside the desired report. If a control section was not selected prior

```
-----------------  GTOS - GADG - SEND DATA TO ACQDATA TASK  -----------------
COMMAND ===> _

   S/C => 1234 (NNNN)
   V/C => 01   (NN)

   Enter:

       TCOPS Vector Hold File DDName => TVINIT1   (AAAAAAA)
             Element Set Number      => 0010      (NNNN)

   OR

       Ephem File DDName             =>           (AAAAAAA)




Commands
 EXEC   - Send Message to Acqdata Task
 CANCEL - Exit Panel Without Action

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-14. ACQDATA Task Panel (1 of 2)

```
HELP  -------------------  SEND DATA TO ACQDATA TASK  -------------------  HELP
COMMAND ===> _

        The following criterias are necessary for
        sending a message to Aqdata task:
        1  A valid SIC/VIC
        2  Either a TVHF DDName or an Ephemeris File DDName
           but not both
        3  An element set number with the TVHF DDName

Commands
 ENTER = Next Page (exit if last)      DOWN = Next Page (if any)
 END   = Exit This Help Display        UP   = Previous Page (if any)

Outstanding messages   Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-14. ACQDATA Task Panel (2 of 2)

```
----------------- GTDS - GRPT - BROWSE REPORTS MENU --------------------------
COMMAND ===> _

 EPHEM    REPORTS  Enter an 'S' before the report to be browsed

         EPHEMERIS REPORT
         ORBIT GENERATION SUMMARY
         ERROR MESSAGES






Commands
 EXEC   = Execute Request
 CANCEL = Exit Panel Without Action

Outstanding messages   Critical     0 (  0%)   Non-critical     0 (  0%)
```

Figure 3-15. Browse Reports Menu (1 of 2)

```
HELP  ----------------------  BROWSE REPORTS MENU  --------------------  HELP
COMMAND ===> _

        The BROWSE REPORTS MENU allows the user to view GTDS
        SCAN file reports  Select the report to be browsed by
        entering 's' before the report name, and enter EXEC on
        the command line  To leave BROWSE and return to the REPORTS
        panel, press the END function key or enter END on the BROWSE
        command line

        To leave the BROWSE REPORTS panel and return to the GTDS
        main options menu, enter CANCEL

Commands
 ENTER - Next Page (exit if last)       DOWN = Next Page (if any)
 END   = Exit This Help Display         UP   = Previous Page (if any)

Outstanding messages  Critical   0 (  0%)   Non-critical   0 (  0%)
```

Figure 3-15. Browse Reports Me... of 2)

to entering this menu, a message is displayed to the user to select a control section.

Once a report is chosen, the user must enter the "EXEC" command or press the appropriate function key. The user then will enter the graphics package browse utility with the chosen report displayed. To exit the panel displaying the report, the user must enter the "END" command or press the appropriate function key. The user then will return to the browse reports menu.

To exit the browse reports menu, the user must enter the "CANCEL" command or press the appropriate function key.

3.11.1.3.11 Display Ephemeris Differences Plot

If the user selects option 11 on the GTDS processing commands menu, the view ephemeris differences plot panel will be displayed (Figure 3-16). The user must run a COMPARE Program to generate data to be plotted on the ephemeris differences plot before entering this option.

The user can select how the plot will be displayed by selecting the plot mode. Selecting "I" allows user interaction; "N" does not allow user interaction. Once the plot mode has been selected, the user must enter the "EXEC" command. After a few moments the user will see the plot displayed. To terminate the interactive plot select "EXIT" with the locator device attached to the 5080 graphics terminal. To terminate from the noninteractive plot, press any key on the keyboard. Exiting either type of plot will return the user to the view ephemeris differences plot panel.

To exit the ephemeris differences plot panel, the user must enter the "CANCEL" command. He or she then will return to the GTDS processing commands menu.

```
-------------- GTDS - GEPL - VIEW EPHEMERIS DIFFERENCES PLOTS --------------
COMMAND ===> _

Ephemeris Differences Plot Coordinates => RVEL      (Choose up to 3
                                       =>            coordinates)
                                       =>

Plot mode             ==> I        (I=interactive or N=Non-interactive)

  Available Coordinates:
    Cartesian Position:    XPOS, YPOS, ZPOS
    Cartesian Velocity:    XVEL, YVEL, ZVEL
    Orbit Plane Position   APOS, CPOS, RPOS
    Orbit Plane Velocity   AVEL, CVEL, RVEL

Commands:
 EXEC   = Execute Request
 CANCEL = Exit Panel Without Action

Outstanding messages: Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-16. View Ephemeris Differences Plot (1 of 2)

```
HELP  ----------------  VIEW EPHEMERIS DIFFERENCES PLOT  ---------------  HELP
COMMAND ===> _

        The EPHEMERIS DIFFERENCES PLOT panel allows the user to
        enter coordinates to be plotted after each GTDS run.

        The user may enter up to three coordinates  The first
        line must contain an entry before executing this panel

        The user can select how the plot will be displayed.
        "I" allows user interaction and "N" does not allow user
        interaction. To terminate the interactive plot select "EXIT"
        with the locator device and to terminate from the
        non-interactive plot, depress any key on the keyboard

Commands
 ENTER = Next Page (exit if last)       DOWN = Next Page (if any)
 END   = Exit This Help Display         UP   = Previous Page (if any)

Outstanding messages  Critical     0 (  0%)   Non-critical     0 (  0%)
```

Figure 3-16. View Ephemeris Differences Plot (2 of 2)

3.11.1.3.12 Display Residuals Plot

If the user selects option 12 on the GTDS processing commands menu, the view residuals plot panel is displayed (Figure 3-17). The user must run a DC Program to generate data to be plotted on the residuals plot before entering this option.

The user can select how the plot will be displayed by selecting the plot mode. Selecting "I" allows user interaction; "N" does not allow user interaction. Once the plot mode has been selected, the user must enter the "EXEC" command. After a few moments the user will see the plot displayed. To terminate the interactive plot, select "EXIT" with the locator device attached to the 5080 graphics terminal. To terminate from the noninteractive plot, press any key on the keyboard. Exiting either type of plot will return the user to the view residuals plot panel.

To exit the residuals plot panel the user must enter the "CANCEL" command. He or she then will return to the GTDS processing commands menu.

3.11.1.3.13 Browse Spooled Output

When the user selects option 13 on the GTDS processing commands menu, the user will enter the graphics package browse utility with the spooled output from the currently run GTDS job displayed (Figure 3-18). If a GTDS job was not submitted, the user will see a message from the browse utility and an empty browse panel.

To exit the browse panel, the user must enter the "END" command or press the appropriate function key. The user then will return to the GTDS processing commands menu.

```
---------------------- GTDS - GRPL - VIEW RESIDUALS PLOT --------------------
COMMAND ===> _

 Satellite Name: ABCD                     Satellite Id  750330

 Select the process for Data ==> B        (B=Batch or T=Time)

 Plot mode        ==> I                   (I=Interactive or N=Non-interactive)

 If by Time
  Start           ==>                     (YY/DDD/HH MM SS SSS - If blank, process
                                                                               
  Stop            ==>                     (YY/DDD/HH MM SS SSS)  entire file

  Data Acronym ==:            ==>         (Up to 2 Aaaa)

 ENTER 'S' BEFORE THE DATA ACRONYM SECTION, ALLOWING UP TO 2

   DATA
   ACRONYM      STATION  TRACKER         START TIME               STOP TIME
   -------      -------  --------        ----------               ---------
   X30          ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   Y30          ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   RANG         ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   RRAT         ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   AZ           BDAQ     C-BAND     75/267/14 00 00 000    75/267/14 05 00 000
   EL           BDAQ     C-BAND     75/267/14 00 00 000    75/267/14 05 00 000
   RANG         BDAQ     C-BAND     75/267/14 00 00 000    75/267/14 05 00 000
   UX30         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
   UY30         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
   URAN         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
   URDF         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
   X30          ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   Y30          ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   RANG         ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   RRAT         ROSV     VHF        75/267/14 00 00 000    75/267/14 05 00 000
   AZ           BDAQ     C-BAND     75/267/14 00 00 000    75/267/14 05 00 000
   EL           BDAQ     C-BAND     75/267/14 00 00 000    75/267/14 05 00 000
   RANG         BDAQ     C-BAND     75/267/14 00 00 000    75/267/14 05 00 000
   UX30         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
   UY30         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
   URAN         UPSX     SRE-VHF    75/267/14 00 00 000    75/267/14 05 00 000
Commands
 EXEC   = Execute Request
 CANCEL = Exit Panel Without Action

Outstanding messages  Critical  0 ( 0%)  Non-critical  0
```

Figure 3-17. View Residuals Plot (1 of 2)

```
HELP ---------------------- VIEW RESIDUALS PLOT ---------------------- HELP
COMMAND ===> _

        The RESIDUALS PLOT panels provides the capability for the
        user to (1) manually select data types for batch processing,
        or (2) enter up to two data types for time processing.
        The data types selected or entered will be plotted
        after each GTDS run.

        To process by TIME(T), enter the start and end times.
        If no start and end times are entered, then the entire
        file will be plotted.  You must also enter one or two data
        types in the space provided.

        To process by BATCH(B), enter and "S" next to the desired
        data types to be plotted.

        The user can select how the plot will be displayed.
        "I" allows user interaction and "N" does not allow user
        interaction.  To terminate the interactive plot select "EXIT"
        with the locator device and to terminate the non-interative
        plot, depress any key on the keyboard.




Commands
 ENTER = Next Page (exit if last)       DOWN = Next Page (if any)
 END   = Exit This Help Display         UP   = Previous Page (if any)

Outstanding messages   Critical     0 (  0%)   Non-critical     0 (  0%)
```

Figure 3-17. View Residuals Plot (2 of 2)

```
BROWSE --- TCSXX KAYRN SYSOUT3 DATA
COMMAND ===> _

DDNAME: GTDSOUT                                                                          SCROLL ===> PAGE
************************************************************** TOP OF DATA ***************************************************************
                    CONTROL  EPHEM                                              TDRS-1     3302602
                    EPOCH     0  0   0 0  560420000000000+06 0 000000000000000+00 0 000000000000000+00
                    ELEMENT1  1  1   1-0  410386483140060+05 0 168920303231000+04 0 673413012164000+03
                    ELEMENT2  0  0   0-0  707898513206060+00-0 299136843901000+01-0 184746238820000-01
                    ORBTYPE   2  1   1 0  600000000000000+03 0 000000000000000+00 0 000000000000000+00
                    OUTPUT    2  1   1 0  360421000000000+06 0 100000000000000+06 0 120000000000000+04
                    OGOPT     0  0   0 0  000000000000000+00 0 000000000000000+00 0 000000000000000+00
                    OUTOPT    3  2   2 0  360420000000000+12 0 860421100000000+12 0 000000000000000+00
                    MAXDECEQ  1  0   0 0  300000000000000+01 0 000000000000000+00 0 000000000000000+00
                    MAXORDEQ  1  0   0 0  300000000000000+01 0 000000000000000+00 0 000000000000000+00
                    MAXORDVE  1  0   0 0  400000000000000+01 0 000000000000000+00 0 000000000000000+00
                    MAXDEGVE  1  0   0 0  400000000000000+01 0 000000000000000+00 0 000000000000000+00
                    SOLRAD    1  0   0 0  100000000000000+01 0 000000000000000+00 0 000000000000000+00
                    SOLRDPAR  2  0   0 0  142698170000000+01 0 000000000000000+00 0 000000000000000+00
                    SCPARAM   0  0   0 0  400000000000000-04 0 176400000000000+04 0 000000000000000+00
                    END       0  0   0 0  000000000000000+00 0 000000000000000+00 0 000000000000000+00
                    FIN       0  0   0 0  000000000000000+00 0 000000000000000+00 0 000000000000000+00
1 .                                       GTDS  EPHEM     PROGRAM                                               PAGE     5

0CONTROL EPHEM                                      TDRS-1  8302602
0CARD NO =     1  CARD IMAGE -- EPOCH        0   0   0      360420 00000000      0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =     2. CARD IMAGE -- ELEMENT1     1   1   1     -41038 648314000      1689 2030323100        673 41301216400       --
0CARD NO =     3. CARD IMAGE -- ELEMENT2     0   0   0     -0 707898513206000   -2 99136843901000     -0 184746838820000E-01 --
0CARD NO =     4. CARD IMAGE -- ORBTYPE      2   1   1      600 0000000000       0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =     5. CARD IMAGE -- OUTPUT       2   1   1      360421 00000000      100000 00000000       1200 000000000      --
0CARD NO =     6. CARD IMAGE -- OGOPT        0   0   0    0 000000000000000E+00  0 000000000000000E+00  0 000000000000000E+00 --
 START OF ORB GENE DECK PROCESSING
0CARD NO =     7  CARD IMAGE -- OUTOPT       3   2   2      360420000000 00      860421100000 00      0 000000000000000E+00 --
0CARD NO =     8. CARD IMAGE -- MAXDECEQ     1   0   0      3 000000000000000    0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =     9. CARD IMAGE -- MAXORDEQ     1   0   0      3 000000000000000    0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =    10. CARD IMAGE -- MAXORDVE     1   0   0      4 000000000000000    0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =    11. CARD IMAGE -- MAXDEGVE     1   0   0      4 000000000000000    0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =    12. CARD IMAGE -- SOLRAD       1   0   0      1 000000000000000    0 000000000000000E+00  0 000000000000000E+00 --
0CARD NO =    13. CARD IMAGE -- SOLRDPAR     2   0   0      1 426981700000000    0 000000000000000E+00  0 000000000000000E+00 --

 ***GTDS MESSAGE 451  ***    1   0 ERRORS TO DATE) ******************************************************************.
                                 SOLAR RADIATION SWITCH ON FOR SECTION 1  (SETOBJ)

0CARD NO =    14. CARD IMAGE -- SCPARAM      0   0   0    0 400000000000000E-04   1764 000000000       0 000000000000000E+00 --
0CARD NO =    15. CARD IMAGE -- END          0   0   0    0 000000000000000E+00  0 000000000000000E+00  0 000000000000000E+00 --
Outstanding messages   Critical     0 (   0%)    Non-critical     0 (   0%)
```

Figure 3-18. View Panels With Spooled Output (1 of 11)

```
HELP --------------------------- BROUSE PANEL -------------------------- HELP
COMMAND ===> _


                     ---------------------------
                     |      BROUSE PANEL        |
                     ---------------------------

The BROWSE panel allows you to inspect the contents of the file allocated to
the specified DDNAME, in full screen format

DISPLAY FORMAT

A description of each field of the BROWSE panel is shown below

    -------------------------------------------------------------
(1) => BROWSE --- <data set name>
(2) => COMMAND ===>
(3) =>

(4) => DDNAME  <DDNAME>                          SCROLL ===> [illegible] = (5)
(6) =>

    -------------------------------------------------------------


(1) Title - (protected) Displays the name of the data set and the member (if
            any) allocated to the specified DDNAME

(2) Command Line - (unprotected) Area where a BROWSE command or a basic
            operator command is entered

(3) Messages - (protected) Area where the advisory messages or the short help
            are displayed

(4) DDNAME - (protected) Shows the DDNAME being browsed

(5) Scroll Amount - (unprotected) Area where the scroll amount is specified
            The valid values are 'PAGE', 'HALF', or a number of lines

(6) Text Area - (protected) Area containing a portion of the data set being
            browsed

   Continued on next page  Press ENTER for next page

Outstanding messages:  Critical    0 (  0%)  Non-critical   0 (  0%)
```

Figure 3-18. View Panels With Spooled Output (2 of 11)

```
HELP ---------------------------- BROUSE PANEL -------------------------- HELP
COMMAND ===> _

BROUSE CAPABILITIES

The operations that can be performed in the BROUSE panel are the following

- Examine 42 lines of text at a time on the IBM 5080 or 30 lines on the IBM
  3270

- View 80 or 132 columns at a time in operator-controlled width (only 80
  columns on the IBM 3270)

- Scroll up or down in operator-controlled increment

- Go to the beginning or end of the file

- Search forward or backward for a specified string

- Print the entire data set to the specified destination

The operator can enter in the command line field any BROUSE command, described
on next page, to perform a brouse operation, or any basic operator command
(i.e. END, HELP, etc.), except for the PAGE command, to perform a display
operation



      Press ENTER for next page [illegible]

Outstanding messages   Critical   0 (  0%)   Non-critical   [illegible]
```

Figure 3-18. View Panels With Spooled Output (3 of 11)

```
HELP -------------------------- BROWSE PANEL -------------------------- HELP
COMMAND ===> _

BROWSE COMMANDS

COMMAND ===> TOP                                   (it can be abbreviated T)

Scrolls up to the top of the data set

COMMAND ===> BOTTOM                                (it can be abbreviated B)

Scrolls down to the bottom of the data set

COMMAND ===> UP <scroll number>                    (it can be abbreviated U)

Scrolls up the range of lines specified by the scroll number. If the scroll
number is not specified, the value of the scroll field (PAGE , HALF , or
a number) will be used

COMMAND ===> DOWN <scroll number>                  (it can be abbreviated D)

Scrolls down the range of lines specified by the scroll number. If the scroll
number is not specified, the value of the scroll field (PAGE , HALF , or
a number) will be used

COMMAND ===> FIND <string>                         (it can be abbreviated F)

Searches down for the next line containing one or more occurrences of the
string. If the line is found, it will be displayed on the second row, and
an advisory message will inform the operator how many occurrences of the
string are found in the line. If the string is not specified, it searches
down for the next occurrence of the string. If the string is specified but
not found or no more occurrence of the string is found, an advisory message
is issued.

COMMAND ===> FINDB <string>                        (it can not be abbreviated)

Searches up for the next line containing one or more occurrences of the
string. If the line is found, it will be displayed on the second row, and
an advisory message will inform the operator how many occurrences of the
string are found in the line. If the string is not specified, it searches
up for the next occurrence of the string. If the string is specified but
not found or no more occurrence of the string is found, an advisory message

    Press ENTER for next page, or enter UP for previous page

Outstanding messages.  Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-18. View Panels With Spooled Output (4 of 11)

```
HELP -------------------------- BROWSE PANEL -------------------------- HELP
COMMAND ===> _

is issued.

COMMAND ===> WIDTH <column width>              (it can be abbreviated W)

Changes the display body to 80- or 132-column font according to the width
number specified. If the width specified is <= 80, then it changes to 80-
column font; Otherwise, 132-column font (only on IBM 5080). If the width
number is not specified, then it toggles from 80 to 132 columns or vice versa.
This command is only executable on the IBM 5080 graphics device.

COMMAND ===> PRINTF <DESTINATION(printer)> <COPIES(no. of copies)>

                                               (it can not be abbreviated)

Prints the entire data set to the printer specified in the DESTINATION operand
the number of copies specified in the COPIES operand. If the destination is
not specified, then the data set will be printed in the local printer. If the
number of copies is not specified, it will print one copy.

The identifiers DESTINATION and COPIES could be specified by their first
letter(s). The delimiter for their values could be either parenthesis, equal
sign, or a space. An example of invoking this command could be as follows:

   PRINTF DEST=prtss C(2)

NOTES ABOUT SOME BASIC OPERATOR COMMANDS

END  Terminates the browse session. If the entry panel was displayed before
     the browse panel, then you will go back to the entry panel and the
     DDNAME, ASCII flag, scroll amount, and width will be saved.

CANCEL  Terminates the browse session. If the entry panel was displayed before
     the browse panel, then you will go back to the entry panel and the
     DDNAME, ASCII flag, scroll amount, and width will not be saved.

RETURN  Terminates the browse session. If the entry panel was displayed before
     the browse panel, then, by issuing this command, you will avoid going
     back to the entry panel.

<ENTER>  Stays on the same page. If the scroll field is altered and ENTER is

    Enter the END command to exit help

Outstanding messages:  Critical    0 (  0%)   Non-critical    0 (  0%)
```

Figure 3-18. View Panels With Spooled Output (5 of 11)

```
HELP --------------------------- BROWSE PANEL --------------------------- HELP
COMMAND ===> _

     pressed, its value will be saved

PAGE  This command is not valid in the browse panel




    Enter the END command to exit help
Outstanding messages  Critical                Non-critical
```

Figure 3-18. View Panels With Spooled Output (6 of 11)

```
//ZB2KBEXS JOB (BTCOP,MMDM,NNN),'MSE EXEC',MSGLEVEL=(1,1),
//      MSGCLASS=X,CLASS=J,TIME=(3,0),NOTIFY=ZB2KB
//*ROUTE PRINT F1VM.BELHI1
//*JOBPARM LINES=80
//PROCLIB DD DSN=TCSXX.MAINT.NEW.PROCLIB,DISP=SHR
//INITDA  EXEC PGM=INITDA
//STEPLIB DD DISP=SHR,DSN=SYS3.LINKLIB
//SYSDA   DD DISP=(NEW,PASS),DSN=&LIBWORK,
//           DCB=(RECFM=F,LRECL=1280,BLKSIZE=1280,DSORG=DA),
//           SPACE=(TRK,(50,5)),UNIT=SYSDA
//SCANS EXEC SCANS,ID=KAYRM
//*
//*  NOTES ON USE:
//* 1. SO THAT YOU DO NOT INTERFERE WITH OTHER USERS, USE A 'UNIQUE'
//*    ID IN THE EXECUTION OF THE SCANS PROC ABOVE. IT CAN BE ANY
//*    SET OF CHARACTERS (UP TO 8) THAT BEGINS WITH AN ALPHA CHARACTER.
//*    FOR EXAMPLE SET ID=AAAAAB2.
//* 2. INSERT THE APPROPRIATE DEVICE ADDRESS FOR DDNAME 'GRAF' BELOW.
//* 3. INSERT THE APPROPRIATE DSN AND MEMBER (PDS ONLY) FOR THE
//*    GTDS KEYWORD CARD DECK IN THE DD STATEMENT FOR DDNAME 'GTDSCPF'
//*    BELOW.
//* 4. INSERT SPECIAL GTDS (ONLY,PLEASE) FILES PECULIAR TO YOUR RUN
//*    APPROPRIATELY BELOW.
//* 5. CHANGE 'ZBDRS' TO 'YOUR ID' IN THE JCL BELOW
//*    FOR ALL DATASETS THAT ARE CREATED TEMPORARILY (PREVENTS CONFLICTS
//*    WITH USERS RUNNING THIS JOB SIMULTANEOUSLY).
//* 6. SUBMIT.
//* 7. REMEMBER TO BRING DOWN GTDS, WHEN FINISHED, WHILE STILL IN THE
//*    GUI.
//*
//*
//GO   EXEC PGM=MSEXEC,REGION=5600K
//*
//STEPLIB   DD   DISP=SHR,DSN=TCSXX.KAY.LOAD3
//          DD   DISP=SHR,DSN=ZBCOP.MSE.LOAD917
//          DD   DISP=SHR,DSN=ZBCOP.IJC.LOAD917
//          DD   DISP=SHR,DSN=ZBCOP.GTDS30.LOAD928
//          DD   DISP=SHR,DSN=GRAPH.TXDP2.LOAD
//EXECLIB   DD   DISP=SHR,DSN=TCSXX.KAY.LOAD3
//          DD   DISP=SHR,DSN=ZBCOP.MSE.LOAD917
//          DD   DISP=SHR,DSN=ZBCOP.IJC.LOAD917
//          DD   DISP=SHR,DSN=ZBCOP.GTDS30.LOAD928
//          DD   DISP=SHR,DSN=GRAPH.TXDP2.LOAD
//FT05F001 DD *
 &NAM1
 SUBSYA='GTUI',
 FREQSA=28000.
 UNIT=007,
 LMNAME(1)='IJCSDR',
 PARMS(1)='MSEGIFMSG  0050',
 QMAXES(1,1)=10,QMAXES(1,2)=10,QMAXES(1,3)=50,QMAXES(1,4)=10,
 PRTIES(1)=1,
 LMNAME(2)='GUI',
 PARMS(2)='01ADG FGTDSTLNCHFTBA FUGGT              TCMSGS,222,7,70,-1',
 QMAXES(2,1)=5,
 PRTIES(2)=1,
 BUFSZE=144,656,0,0,0,
 BUFNO(1)=50,20,0,0,0
 &END
//IJCNTWK DD *
 &NETWK
 &END
 //*
 //JMLIST DD *
 &SUBTSK
 LIST='TSKRPT  ','GUI     ','GIFMSG  ','IJCSDR  ','IJCRCV  ',
      'TBARPT  ','TBAPLT  ','TBADSP  ','TBMAIN  ','TCPRPT  ',
      'LTASRV  ','DIGSRV  ','TDRECV  ','TRAJGD  ','DIFFPT  ',
      'SRCSEL  ','VECRPT  ','SPHELM  ','LCPRPT  ','LDNOM   ',
      'AQGEN   ','AQTRAN  ','AQRPT   ','TDRSVW  ','GTDS    ',
      'GCOPY   ','PROP    ','        ','        ','        ',
      '        ','        ','        ','        ','        ',
 &END
//FT06F001 DD   SYSOUT=X
//*
//* INSERT DEVICE ADDRESS HERE:
//GRAF      DD   UNIT=E88
//TDWORK    DD   UNIT=VIO,SPACE=(CYL,2),DCB=DSORG=DA
//TCMSGS    DD   UNIT=VIO,DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200),
//               SPACE=(CYL,1)
//TXLIB     DD   DISP=SHR,DSN=TCSXX.GTDSUI.DISPLIB
//WEBSTER   DD   DISP=SHR,DSN=TCSXX.GTDSUI.DATADICT
```

Figure 3-18. View Panels With Spooled Output (7 of 11)

```
//*
//* INSERT GTDS KWC CARD DECK HERE:
//GTDSCPF  DD  DISP=SHR,DSN=TCSXX.GTDS.KWCFILE
//GTDSWPF  DD  DISP=SHR,DSN=TCSXX.GTDS.WORKPMTR
//GTDSPRM  DD  DISP=SHR,DSN=TCSXX.GTDSUI.PARMS
//GTDSOUT DD DISP=SHR,DSN=*.SCANS.ALLOC.GTDSOUT
//F229F001 DD DSN=ZBCOP.REL3.RPTTOC,DISP=SHR
//F100F001 DD DSN=ZBCOP.REL3.RPTTOC,DISP=SHR
//F230F001 DD DSN=ZBCOP.REL3.REPORTS,DISP=SHR
//F102F001 DD DSN=ZBCOP.REL3.REPORTS,DISP=SHR
//*  TCOPS VECTOR HOLD FILE DEFINITION
//TVINIT1 DD DSN=ZB2KB.TCOPS.TVHF1,DISP=(MOD,CATLG),UNIT=DISK,
//    SPACE=(TRK,5),DCB=(RECFM=F,LRECL=472,BLKSIZE=472)
//TVINIT  DD DSN=TCSXX.MAINT.TVHF.DATA,DISP=SHR
//FT24F001 DD DSN=ZB2KB.EPHEM1.DATA, 1ST ORB1 OR EPHEM OUTPUT FILE
//       UNIT=DISK,DISP=(,PASS,DELETE),       OR   DISP=(NEW,CATLG),
//       DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=1),
//       SPACE=(TRK,(1,10))
//* ENTER EPHEM FILE HERE
//* NEED TO BE CAREFUL ABOUT DISP= FOR EPHEM FILES (EPHCMP, EPHEM)
//EPHEM1  DD DSN=ZB2KB.EPHEM2, 1ST ORB1 OR EPHEM OUTPUT FILE
//       UNIT=DISK,DISP=(,PASS,DELETE), DISP=(NEW,CATLG),
//       DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=1),
//       SPACE=(TRK,(1,10))
//FT81F001 DD DSN=ZB2KB.EPHEM8, 2ND ORB1 OR EPHEM  FILE (I/O)
//             UNIT=DISK,DISP=(,PASS,DELETE),  (OR DISP=SHR)
//             SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=1)
//EPHEM2 DD DSN=ZB2KB.EPHEM9, 2ND ORB1 OR EPHEM  FILE (I/O)
//             UNIT=DISK,DISP=(,PASS,DELETE), (OR DISP=SHR)
//             SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=1)
//FT55F001 DD  DISP=SHR,DSN=SYS2.TEMPLATS.FONT,LABEL=(,,,IN)
//FT63F001 DD  DISP=(OLD,DELETE),DSN=&LIBWORK
//F155F001 DD  DISP=SHR,DSN=ZBCOP.STATN.GEODNEW
//F227F001 DD  DISP=SHR,DSN=ZBCOP.STATN.GEODNEW
//F238F001 DD  DISP=SHR,DSN=ZBCOP.LAUNCH.CP
//FT07F001 DD  DISP=SHR,DSN=TCSXX.ACTIVITY.LOG.DATA
//F222F001 DD  DISP=SHR,DSN=TCSXX.GUI.PMF
//FT70F001 DD  DISP=SHR,DSN=ZBCOP.REL3.JLF
//F225F001 DD  DISP=SHR,DSN=ZBCOP.SYSTEM.STATUS.PAGE.DATA
//*********** SCAN FILES ***********
//*
//FT42F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD42
//GTDSORR  DD   DISP=SHR,DSN=*.FT42F001
//FT43F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD43
//GTDSSPR  DD   DISP=SHR,DSN=*.FT43F001
//GTDSEDC  DD   DISP=SHR,DSN=*.FT43F001
//FT44F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD44
//GTDSELR  DD   DISP=SHR,DSN=*.FT44F001
//GTDSEDR  DD   DISP=SHR,DSN=*.FT44F001
//FT49F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD49
//GTDSDCS  DD   DISP=SHR,DSN=*.FT49F001
//FT28F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD28
//GTDSEPR  DD   DISP=SHR,DSN=*.FT28F001
//FT35F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD35
//GTDSISC  DD   DISP=SHR,DSN=*.FT35F001
//FT36F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD36
//GTDSOGS  DD   DISP=SHR,DSN=*.FT36F001
//FT23F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD23
//GTDSERR  DD   DISP=SHR,DSN=*.FT23F001
//FT47F001 DD   DISP=SHR,DSN=*.SCANS.ALLOC.DD47
//GTDSURC  DD   DISP=SHR,DSN=*.FT47F001
//*
//* FT00F001 IS DUMMY FOR USE IN SUPPRESSION OF OUTPUT
//* BY THMODEL PROGRAM (BATCH,UI,PROP)
//FT00F001 DD DUMMY
//*
//* JCL FOR FILES THAT ARE READ ONLY -- CAN BE USED BY BOTH
//* SUBTASKS (SEPARATE DCB'S)
//*
//FT02F001 DD DISP=SHR,DSN=ORBIT.GTDS.ATMOSDEN.DATA,DCB=BUFNO=1
//FT03F001 DD DISP=SHR,DSN=ORBIT.GTDS.MANEUVER.DATA,DCB=BUFNO=1
//FT04F001 DD DISP=SHR,DSN=ORBIT.GTDS.ASTROCON.DATA,DCB=BUFNO=1
//FT08F001 DD DISP=SHR,DSN=ORBIT.GTDS.EARTHFLD.DATA,DCB=BUFNO=1
//FT09F001 DD DISP=SHR,DSN=ORBIT.GTDS.LUNARFLD.DATA,DCB=BUFNO=1
//FT10F001 DD DISP=SHR,DSN=ORBIT.GTDS.INTCDEF.DATA,DCB=BUFNO=1
//FT11F001 DD DISP=SHR,DSN=ORBIT.GTDS.SECTIONS.DATA,DCB=BUFNO=1
//FT13F001 DD DISP=SHR,DSN=ZBCOP.GTDS.ERRORMSG.DATA,DCB=BUFNO=1
//FT14F001 DD DISP=SHR,DSN=ORBIT.GTDS.SLP1950.DATA,
//      LABEL=(,,,IN),DCB=BUFNO=1
```

Figure 3-18. View Panels With Spooled Output (8 of 11)

```
//FT25F001 DD DISP=SHR,DSN=ORBIT.GTDS.ELEMENTS.DATA,DCB=BUFNO=1
//FT27F001 DD DISP=SHR,DSN=ORBIT.GTDS.GEODTICS.DATA,DCB=BUFNO=1
//FT38F001 DD DISP=SHR,DSN=ORBIT.GTDS.TIMCOF.DATA,DCB=BUFNO=1
//FT39F001 DD DISP=SHR,DSN=ORBIT.GTDS.GENCOF.DATA,DCB=BUFNO=1
//FT59F001 DD DISP=SHR,DSN=ORBIT.GTDS.SOLDAT.DATA,DCB=BUFNO=1
//FT60F001 DD DISP=SHR,DSN=ORBIT.GTDS.ACCOUNT.DATA,
//      DCB=BUFNO=1
//FT68F001 DD DISP=SHR,DSN=ORBIT.GTDS.TRODAT.DATA,DCB=BUFNO=1
//FT75F001 DD DISP=SHR,DSN=ORBIT.GTDS.JACCHIA.DATA,DCB=BUFNO=1
//FT78F001 DD DISP=SHR,DSN=ORBIT.GTDS.SLPTOD.DATA,DCB=BUFNO=1
//* FILES UNIQUE TO UI
//FT01F001 DD DSN=ZB2KB.INDEX.DATA,UNIT=DISK,DISP=(,PASS,DELETE),
//      SPACE=(TRK,(9)),DCB=(RECFM=FBA,LRECL=133,BLKSIZE=133)
//FT12F001 DD DUMMY             TEMPORARY DATA FOR CRT INPUT MODE
//FT16F001 DD DSN=&&F16,        DATA SIMULATION SUMMARY WORKING FILE
//      UNIT=DISK,SPACE=(124,700),DCB=(DSORG=DA,BUFNO=1)
//FT17F001 DD DSN=&&F17,        OBSERVATIONS WORKING FILE
//      UNIT=DISK,
//      DCB=(RECFM=FB,LRECL=184,BLKSIZE=6072,BUFNO=1),
//      SPACE=(6072,(100,40),,,ROUND)
//FT18F001 DD DSN=&&F18,        SLP WORKING FILE
//      UNIT=DISK,SPACE=(2264,48),DCB=(DSORG=DA,BUFNO=1)
//FT19F001 DD DSN=&&F19,        DISK ORBIT FILE WITH PARTIALS
//      DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=1),
//      UNIT=DISK,SPACE=(1024,1500)
//FT20F001 DD DSN=&&F20,        DISK ORBIT FILE WITHOUT PARTIALS
//      UNIT=DISK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=1),
//      SPACE=(1024,500)
//FT21F001 DD DSN=&&F21,        TAPE ORBIT FILE WITH PARTIALS
//      DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=1),
//      UNIT=DISK,SPACE=(TRK,(1,10))
//FT22F001 DD DSN=&&F22,        TAPE ORBIT FILE WITHOUT PARTIALS
//      DCB=(RECFM=VBS.LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=1),
//      UNIT=DISK.SPACE=(TRK.(1,10))
//FT29F001 DD DSN=&&F29, GTDS OBSERVATION TAPE FILE
//      UNIT=DISK.DISP=(,PASS.DELETE),LABEL=(.BLP),
//      DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=1),
//      SPACE=(TRK,(1.10))
//FT30F001 DD DSN=&&F30,             DODS OBSERVATION TAPE
//      DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=1).
//      UNIT=DISK,LABEL=(,BLP),DISP=(,PASS,DELETE),SPACE=(TRK,(1,10))
//FT31F001 DD DSN=&&F31,             GTDS OBSERVATION DISK FILE
//              UNIT=DISK,DISP=(,PASS,DELETE),
//              DCB=(RECFM=F.BLKSIZE=7200),
//              SPACE=(TRK,(2,10),RLSE)
//FT33F001 DD DSN=&&F33,             SLP TAPE
//              DCB=(RECFM=VS.BLKSIZE=3460,DEN=3,BUFNO=1),
//              UNIT=DISK,LABEL=(,BLP),DISP=(,PASS,DELETE),
//              SPACE=(TRK,(1,10))
//FT34F001 DD DSN=&&F34,             JPL TAPE
//              DCB=(RECFM=VBS,LRECL=8304,BLKSIZE=8308,DEN=3.BUFNO=1).
//              UNIT=DISK,LABEL=(.BLP,,IN),DISP=(,PASS,DELETE),
//              SPACE=(TRK,(1,10))
//FT37F001 DD DSN=&&F37.        OBSERVATIONS SORT FILE
//      UNIT=DISK,DISP=(.PASS,DELETE),
//      DCB=(RECFM=VBS,LRECL=188.BLKSIZE=6208,BUFNO=1),
//      SPACE=(TRK.(20,10))
//FT40F001 DD DUMMY             PERMANENT FILES TO SCOPE
//FT41F001 DD DSN=&&F41,        TEMPORARY STARTER ARRAYS
//      UNIT=DISK.SPACE=(TRK,(1,10)),
//      DCB=(RECFM=VBS,LRECL=5796,BLKSIZE=5800,BUFNO=1)
//FT45F001 DD DSN=&&F45,         SCRATCH ORBIT FILE
//      UNIT=DISK,DISP=(,PASS,DELETE),
//      DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172.BUFNO=1),
//      SPACE=(CYL,(5,1))
//FT46F001 DD DSN=&&F46.             OBSERVATION SAVE
//       DCB=(RECFM=VBS.LRECL=7204.BLKSIZE=7208.DEN=3.BUFNO=1).
//       UNIT=DISK,LABEL=(,BLP).DISP=(,PASS.DELETE),SPACE=(TRK.(1,10))
//FT48F001 DD DSN=&&F48.        EARTH/LUNAR POT FIELD WORKING FILE
//      UNIT=DISK,SPACE=(4200,2),DCB=(DSORG=DA,BUFNO=1)
//FT50F001 DD DDNAME=ODDSUM          TRACKING DATA ACQUISITION SUMMARY
//FT51F001 DD DUMMY,            TELETYPE ELEMENTS REPORT
//      DCB=(RECFM=FBA,LRECL=80,BLKSIZE=800,DEN=3,BUFNO=1),
//      UNIT=DISK,SPACE=(CYL,(1,1))
//FT52F001 DD DSN=&&F52,             DATA SIMULATION INPUT DODS TAPE
//              DCB=(RECFM=VBS,LRECL=104.BLKSIZE=1044,DEN=3.BUFNO=1),
//              UNIT=DISK,LABEL=(,BLP),DISP=(,PASS,DELETE),
//              SPACE=(TRK.(1.10))
```

Figure 3-18. View Panels With Spooled Output (9 of 11)

```
//FT53F001 DD DUMMY.          CAIRS REPORT FILE
//         DCB=(RECFM=FB,LRECL=80,BLKSIZE=800),UNIT=DISK,DISP=SHR
//FT54F001 DD DSN=&&F54,           CHEBYSHEV EPHEMERIS FOR FDP-11
//            UNIT=DISK,LABEL=(1,BLP),       UNIT=TAPEDEN2
//            DCB=(RECFM=FB,LRECL=316,BLKSIZE=316,DEN=2,BUFNO=1),
//            SPACE=(TRK,(1,10))
//FT56F001 DD DUMMY      PARTIAL BATCH REQUEST FILE
//FT57F001 DD DSN=&&F57,        SCRATCH AREA FOR COMMON
//      UNIT=DISK,DISP=(,PASS,DELETE),
//      SPACE=(TRK,(5,2)),DCB=BUFNO=1
//FT58F001 DD DSN=&&F58,        IONOSPHERE WORKING FILE
//      UNIT=DISK,DISP=(,PASS,DELETE),
//      SPACE=(1332,20),DCB=(DSORG=DA,BUFNO=1)
//FT61F001 DD DSN=&&F61,UNIT=DISK, RESIDUAL EDIT WORKING FILE
//            DCB=(RECFM=VBS,LRECL=564,BLKSIZE=6208,BUFNO=1),
//            SPACE=(CYL,(6,1)),DISP=(,PASS,DELETE)
//FT62F001 DD DSN=TCSXX.ZBIYW.FT62.TEST.DATA,  RESIDUAL PLOT DATA FILE
//      UNIT=DISK,DCB=(RECFM=FB,LRECL=160,BLKSIZE=3520),
//      SPACE=(TRK,(100,50)),DISP=(MOD,CATLG)
//FT64F001 DD DSN=&&F64,           SOR EXTRACT FILE
//            DCB=(RECFM=VBS,LRECL=132,BLKSIZE=3304,DEN=3,BUFNO=1),
//            UNIT=DISK,DISP=(,PASS,DELETE),SPACE=(TRK,(1,10)),
//            VOL=SER=
//FT65F001 DD DSN=&&F65,        IONOSPHERE WORKING FILE
//            UNIT=DISK,DISP=(,PASS,DELETE),
//            SPACE=(1176,62),DCB=(DSORG=DA,BUFNO=1)
//FT66F001 DD DSN=&&F66,           IONSPHERIC SAVE FILE
//            DCB=(RECFM=VBS,LRECL=1180,BLKSIZE=1184,BUFNO=1),
//            SPACE=(TRK,(3,1),RLSE),UNIT=DISK
//FT67F001 DD DSN=&&F67,           REAL TIME IONOSPHERE DATA
//            UNIT=DISK,SPACE=(1432,151),DCB=(DSORG=DA,BUFNO=1),
//            DISP=(,PASS,DELETE)
//FT69F001 DD DUMMY  ORBIT.GTDS.PROMPT.DATA(GRAPHICS PROMPT DATA)
//FT71F001 DD DSN=TCSXX.MAINT.PTOF1B.DATA,DISP=SHR
//FT72F001 DD DUMMY         PTOF FOR TDRS3
//FT73F001 DD DUMMY         PTOF FOR TDRS7,DISP=SHR
//FT74F001 DD DUMMY                GRAPHICS INTERRUPT FILE
//FT76F001 DD DSN=&&F76,              GMAN OUTPUT FILE
//            UNIT=DISK,
//            SPACE=(TRK,(1,10)),DISP=(,PASS,DELETE),
//            DCB=(RECFM=VBS,BLKSIZE=8764,LRECL=1940)
//FT77F001 DD DSN=&&F77,        EPHEM WORKING FILE
//            UNIT=DISK,DISP=(,PASS,DELETE),
//            SPACE=(2800,350),DCB=(RECFM=FT,BLKSIZE=2800,BUFNO=1)
//FLSCF1   DD DSN=TCSXX.FSF.DATA,DISP=SHR   FLIGHT SECTIONING FILE
//FT79F001 DD DSN=TCSXX.FSF.DATA,DISP=SHR   FLIGHT SECTIONING FILE
//FT80F001 DD DSN=&&F80,        TARGET ORBIT FILE
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=1),
//            SPACE=(CYL,(4,1)),UNIT=DISK,DISP=(,PASS,DELETE)
//FT82F001 DD DSN=&&F82,           COMPARE SEQ ORBIT FILE 2, WITH PARTS
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=1),
//            UNIT=DISK,LABEL=(,BLP),DISP=(,PASS,DELETE),
//            SPACE=(TRK,(1,10))
//FT83F001 DD DSN=&&F83,        3RD ORB1 OR EPHEM OUTPUT FILE
//            UNIT=DISK,DISP=(,PASS,DELETE),
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=1)
//FT84F001 DD DSN=&&F84,           COMPARE SEQ ORBIT FILE 2, W/O PARTS
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=1),
//            UNIT=DISK.LABEL=(,BLP),DISP=(,PASS,DELETE),
//            SPACE=(TRK,(1,10))
//FT85F001 DD DSN=&&F85,        4TH ORB1 OR EPHEM OUTPUT FILE
//            UNIT=DISK,DISP=(,PASS,DELETE),
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=1)
//FT86F001 DD DSN=&&F86,           COMPARE DA ORBIT FILE 2, WITH PARTS
//            UNIT=DISK,DCB=(RECFM=F,BLKSIZE=1024.DSORG=DA,BUFNO=1),
//            SPACE=(1024,1500),DISP=(,PASS,DELETE)
//FT87F001 DD DSN=&&F87,        5TH ORB1 OR EPHEM OUTPUT FILE
//     UNIT=DISK,DISP=(,PASS,DELETE),
//     SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808.BUFNO=1)
//FT88F001 DD DSN=&&F88,           COMPARE DA ORBIT FILE 2. W/O PARTIALS
//            UNIT=DISK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=1),
//            SPACE=(1024,500)
//FT91F001 DD DSN=&&F91,           USB OBSERVATIONS (60-BYTE)
//          UNIT=DISK,DCB=(RECFM=VBS,LRECL=64,BLKSIZE=6404,BUFNO=1),
//          DISP=(,PASS,DELETE),SPACE=(TRK,(1,10))
//FT92F001 DD DSN=&&F92,        ERROR ANALYSIS SUMMARY FILE
//     UNIT=DISK,SPACE=(6220,(6,3)),DISP=(,PASS,DELETE),
//     DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=1)
```

Figure 3-18. View Panels With Spooled Output (10 of 11)

```
//FT93F001 DD DSN=&&F93,        ERROR ANALYSIS WORKING FILE
//      UNIT=DISK,SPACE=(6220,(6,11)),DISP=(,PASS,DELETE),
//      DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=1)
//FT94F001 DD DSN=&&F94,              OPTICAL ASPECT DATA
//             DCB=(RECFM=VBS,LRECL=28,BLKSIZE=564,DEN=3,BUFNO=1),
//             UNIT=DISK,LABEL=(,BLP),DISP=(,PASS,DELETE),
//             SPACE=(TRK,(1,10))
//FT95F001 DD DSN=&&F95,        STATISTICAL OUTPUT REPORT FILE
//             UNIT=DISK,SPACE=(CYL,(4,1)),DISP=(,PASS,DELETE),
//             DCB=(RECFM=FB,LRECL=160.BLKSIZE=9440,BUFNO=1)
//FT96F001 DD DSN=TCSXX.MAINT.G20JC.DBM60, 60-BYTE DATA BASE
//             DCB=BUFNO=1,DISP=SHR
//FT97F001 DD DSN=&&F97, RELAY 1 SCRATCH ORBIT FILE
//      DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=1),
//      SPACE=(CYL,(4,1)),UNIT=DISK,DISP=(,PASS,DELETE)
//FT98F001 DD DSN=&&F98,  RELAY 2 SCRATCH ORBIT FILE
//             DCB=(RECFM=FB,LRECL=1024.BLKSIZE=6144,BUFNO=1),
//             SPACE=(TRK,(10,2)),UNIT=DISK,DISP=(,PASS,DELETE)
//FT99F001 DD DSN=&&F99,  RELAY 3 SCRATCH ORBIT FILE
//             DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=1),
//             SPACE=(TRK,(10,2)),UNIT=DISK,DISP=(,PASS,DELETE)
//INPUTPOS DD DUMMY,                CRT INPUT
//          UNIT=DISK,DISP=SHR,
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=7200)
//SYSABEND DD  DUMMY,SYSOUT=X
//NUCLEUS  DD  DISP=SHR,VOL=REF=SYS1.SVCLIB
//SYSUDUMP DD  DUMMY,SYSOUT=X
//ERRDUMP  DD DUMMY,SYSOUT=*
//
```

Figure 3-18. View Panels With Spooled Output (11 of 11)

3.11.2 GTDS AS A SERVICE ORBIT PROPAGATOR

GTDS remains a single load module that is capable of executing in three distinct modes:

1. Batch
2. As an option under the TCOPS user interface (UI)
3. As a service orbit propagator

Options 1 and 2 are discussed elsewhere in this document; this section will explain the use of GTDS as a service orbit propagator for some subtask in the TCOPS multitasking environment. It should be noted that the information provided is programming information and not intended for users-at-large.

3.11.2.1 General Information

GTDS as a service orbit propagator is driven entirely by a FORTRAN unit called UTPROP, resident in the user subtask. Both subtasks (user subtask and GTDS) must exist in the JCL that executes the TCOPS Executive. In this environment, UTPROP exercises total control over GTDS, known in this environment as load module PROP (created in the link step as the GTDS alias).

When brought up by an application via UTPROP, the EPHEM program with all its options for orbit propagation services is the only GTDS service available. When in this mode, all FT06 output is suppressed; any error message is written to a file for later browsing; output vectors are returned to the requesting subsystem in a 50-by-6 array via an intertask communication. An input mode parameter enables GTDS to recognize the mode under which it is executing. Output EPHEM files also are available; their ddnames will be passed by UTPROP. UTPROP also can provide overrides to control information parameters.

3.11.2.2 Input/Output

GTDS has an extensive set of formatted keyword cards that provide for input of its control parameters. These keyword cards will continue to be the prime mechanism for GTDS control parameter input. The subtasking environment, however, allows an application bringing up GTDS for orbit propagation services to directly pass certain overrides to GTDS without the necessity of formatting new keyword cards.

When used for orbit propagation services by another application program, considerable flexibility is provided via the utility UTPROP. This FORTRAN unit (with entry points UTPRPU, UTPRPD, UTPRPS, UTPROP) fulfills several functions for any user application:

- Attach GTDS for an orbit propagation.
- Order GTDS to perform a propagation (GTDS already up).
- Cancel a propagation in progress.
- Detach GTDS.
- Inform GTDS as to its mode of execution (parameter 'MODE', handled by the utility).
- Inform GTDS as to the source of an initial keyword card deck defined in the JCL. (Parameter 'DDIN', passed by application to UTPROP, can be changed each time propagation is ordered.)
- Inform GTDS as to which overrides to apply to the skeleton control information it will soon retrieve (loaded by user task).
- Identify an error message file for error messages (part of parameter 'DDOUT', passed to utility by application program).

- Identify the ddname of an output EPHEM file, if requested.
- Return 6-by-50 array of position and velocity vectors via intertask communication, via the utility in a wait state, or via the application program.
- Give GTDS the load module and queue to which to send the array.

3.11.2.2.1 Input Via UTPROP

Primary input to GTDS remains as described elsewhere in this document. UTPROP provides the capability of overriding the skeleton or default keyword cards defined in parameter 'DDIN' that is passed to GTDS via an intertask message.

UTPROP is a subroutine linked into the application program that accepts full responsibility for handling the GTDS task while needed by the application program. It is invoked by

CALL UTPRPU (IERR) to bring up GTDS and wait for propagation order

or CALL UTPROP (PROP, STAY, LMNAME, IQUE, DDIN, DDOUT, OVRID, IOVRID, LREAL, LINT, VECOUT, IPRPNO, IERR) to order propagation (utility in wait state if STAY = .TRUE.) If PROP = .FALSE., the utility is returning for more vectors.

or CALL UTPRPD (IERR) to bring down GTDS

or CALL UTPRPS (IPRPNO, ISERR) to stop a propagation. (IPRPNO is the propagation number returned previously by UTPRP.)

where:

Variable	Type	I/O	Description
STAY	L*1	I	Wait if true; exit if false
PROP	L*1	I	Order propagation if true; pick up vectors if false
LMNAME	C*8	I	Load module for vector delivery
IQUE	I*4	I	Queue to which vectors delivered
DDIN	C*8	I	ddname for default input keyword card deck for GTDS orbit propagation
DDOUT(2)	C*8	I	ddname for output data set (error messages only) and output EPHEM file
OVRID(40)	R*8	I	Real*8 array containing real overrides
IOVRID(40)	I*4	I	Integer array containing integer overrides
LREAL(40)	L*1	I	Logical array
LINT(40)	L*1	I	Logical array
VECOUT(6,50)	R*8	O	Array of position and velocity vectors
IERR	I*4	O	Return code =0, action successful =1, communication problem =2, action unsuccessful (see output error message file for details)

These latter four arguments in the calling sequences are devoted to a flexible scheme whereby the following GTDS keyword cards can be overridden:

	Integer Index (LINT, IOVRID)			Real Index (LREAL, OVRID)		
Element1	1	2	3	1	2	3
Element2				4	5	6

	Integer Index (LINT, IOVRID)			Real Index (LREAL, OVRID)		
Epoch				7	8	
Output	4	5	6	9	10	11
ORBTYPE	7	8	9	12		
SCPARAM				13	14	
SOLRDPAR				15		
DRAGPAR				16		
OUTOPT	10	11	12	17	18	19
MAXDEGEQ						
MAXORDEQ21						
NCBODY		13	14	22	23	
TOLER	15	16	17	25	26	27

The rest of the 40 positions are spare.

The scheme is based on the nature of the GTDS keyword cards; that is, all GTDS keyword cards have three integer fields followed by three real fields. Thus, to override one of the fields on the aforementioned cards (which must exist in the skeleton deck to which 'DDIN' points):

- Find the location of the field to be overridden.
  - Note its index I.
  - Note its type (integer or real).
- Set either LINT(I) = .TRUE. or LREAL(I) = .TRUE. depending on type.
- Load the override into IOVRID(I) or OVRID(I) depending on type.

Note that this scheme is hidden from the user as part of the software; it is a logically secure scheme for overriding control information in a fixed GTDS keyword card deck ('DDIN') as specific values in a specific situation are determined by the application software. The application software should devote a single unit for loading overrides.

Only two restrictions on overrides exist:

- Each keyword card to be overridden must exist in the keyword card deck defined by 'DDIN'.
- The preceding listing of cards and indices must be followed.

3.11.2.2.2 Output

If brought up by an applications program for orbit propagation, GTDS will provide no browsable output at all except error messages, which will be routed to a data set defined in parameter 'DDOUT(1)' passed to GTDS via UTPROP.

The output array of vectors will be at output stepsizes and in coordinate frames defined by the input keyword card deck ('DDIN') or by overrides via UTPROP. If less than one full 50-by-6 array is filled, the remainder of the array will be zero filled; if more than one array is needed, the application will accept one full array passed out of UTPROP, along with a flag denoting that more are on the way. This procedure can be continued indefinitely. It is the responsibility of the calling task to manage the times of propagation along with 'DDIN' and 'DDOUT', all of which could change each time GTDS is told to propagate.

3.11.2.3 Description of Processing

All necessary input to GTDS is via parameters from the TCOPS multitasking executive or via UTPROP. Several new units enable this processing.

New subroutine MAIN(PARMS) receives the mode parameter from the TCOPS executive when GTDS is brought up; modified unit ODSEXC (old ODSEXEC) decides whether to proceed with a normal GTDS run (batch mode, GTDS task under the UI and, thus, calling SETUI to manage ddnames) or whether its orbit propagation service is being requested, in which case new

unit PRPEXC is called to set GTDS in this mode. PRPEXC is actually a different version of ODSEXC, whose only GTDS function is to call the orbit propagation driver, EPHGEN. PRPEXC also receives output sent via intertask communication from UTPROP and attaches the ddnames sent. PRPEXC also controls the return of vectors to the calling task.

Thus, for any GTDS mode in any mode of execution, either a path is taken through mostly older GTDS code (ODSEXEC) or through PRPEXC.

SECTION 4 - KEYWORD CARD DESCRIPTIONS

As explained in Sections 1 through 3, input to GTDS is provided via keyword cards. The general format of an input deck is described in Section 2, and the input required for specific programs is discussed in Section 3. Section 4 describes each keyword card, its use, and the information that it must contain.

The alphabetical keyword listing includes mandatory keywords, subdeck identifiers, and optional keywords that may be included in subdecks. The name of the keyword appears in the upper right-hand corner of the page for quick reference. Beneath the keyword name, one of the following notations appears:

(mandatory)
(subdeck identifier)
(subdeck1, subdeck2, ...).[1]

Mandatory in parentheses means that the keyword is mandatory; subdeck identifier means that the keyword is a subdeck identifier; and a list with one or more subdeck names means that the keyword may be included in any of the subdecks listed.

The keywords conform to a format, which is supplied on each keyword page. In most cases, this format consists of an alphanumeric field (A8), which contains the keyword (an alphanumeric identifier in card columns 1 through 8); three integer fields (3I3), and three real fields (3G21.14). The three integer fields are commonly referred to as the I1 field, the I2 field, and the I3 field; the three real fields are referred to as the R1 field, the R2 field, and the R3 field. Data values supplied for I1, I2, and I3 must

[1]The terms (subdeck1, subdeck2, ...) represent the names of subdecks.

be punched in integer form (i.e, the data values contain no decimal points) and right justified in the field. Data supplied in the R1, R2, and R3 fields will be accepted by GTDS as double-precision numerical data and must be in a valid floating-point representation (i.e., either a number punched within the field containing a decimal point or a number punched with a D or an E decimal exponent right justified in the field). Any data value supplied for the real fields (even though the data may be a whole number) must be a floating-point representation.

The keyword descriptions state the default data values where they exist. A default value will be used if the data field is blank or if a value of zero is supplied in the field. Any value in the field other than zero or blank will override a specified default.

Unless otherwise specified, the data units used are kilometers, seconds, kilometers/second, and degrees. Dates supplied on GTDS input cards are usually two words in the packed form

yymmdd.
hhmmss.ssss

where

yy	represents the year (e.g., yy is 74 for year 1974)
mm	represents the month
dd	represents the day of the month
hh	represents the hours
mm	represents the minutes
ss.ssss	represents the seconds and fractions of seconds

The information on the remainder of the page(s) includes the keyword name, the format of the input card, a list of programs for which the keyword is applicable, and a detailed description of the information to be included on the card.

All keywords, keyword functions, and applicable programs and subdecks are summarized in Appendix F.

Abbb****

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: Differential Correction (DC), Data Management (DATAMGT)
- Detailed format:

Columns	Format	Description
1-8	A8	Abbb****--keyword to set edit acceptance criteria where the asterisks represent the receive (tracking) station acronym (see Note 1). (See Appendix A, Table A-5, for the 60-byte data base station acronyms.) If all receive stations employing the same tracker type are to be accepted, "ALLX" is used instead of a station acronym, where X specifies the tracker type (see Table 4-1 for values of X). If all receive stations are to be accepted, it is not necessary to input the station acronym or tracker type.
9-11	I3	Satellite object number: For the USB tracking system = the object number For the Applications Technology Satellite (ATS) tracking system = the packed integer IJK where I = relay satellite indicator (e.g., I = 6 for ATS-6) (See Table 4-2 for values of J and K.) For the TDRS tracking system = the packed integer IJK where I = VIC of target for satellite to satellite data, or VIC of return link Tracking and Data Relay Satellite (TDRS) for ground transponder data J = forward-link TDRS ID (see Note 3)

Columns	Format	Description
9-11 (Cont'd)		K = return-link TDRS ID (If I or J or K = 0, do not key on this item.) Default = 0, accept all object numbers
12-14	I3	Frequency at which observations satisfying criteria for the Accept Specification Card are accepted (default = 1) (see Note 6)
15-17	I3	Ground transponder index number (for the TDRS tracking system = the ground transponder index number to be accepted)--default = 0, accepts all ground transponder index numbers (See Appendix A, Table A-5, for ground transponder index numbers.)
18-38	G21.14	Editing on a combination of specifications TTMR (see Note 4): TT = GTDS observation type number (see Appendix A, Table A-2) = 00, do not key on observation type M = equipment mode indicator as defined for C-band, minitrack, USB, ATSR, Cartesian Vector and TDRS tracking systems (See Table 4-3 for values.) = 0, do not key on equipment mode R = data rate indicator as defined for Goddard Range and Range Rate (GRARR), ATSR, and TDRS tracking systems (See Table 4-4 for values.) = 0, do not key on data rate
39-59	G21.14	Start time of span for edit (yymmddhhmmss.ssss); the default is the time of the earliest observation (see Note 5)
60-80	G21.14	End time of span for edit (yymmddhhmmss.ssss); the default is the time of the last observation (see Note 5)

Abbb****
Accept Specification
Card
(DMOPT, DCOPT)

This keyword may be included in either the DMOPT or the DCOPT subdeck, depending on when the user wants the editing to be performed. By placing the keyword in the DMOPT subdeck, editing will be performed as the Observations Working File is being built. Thus, edited observation will not appear in the working file. By placing the keyword in the DCOPT subdeck, editing will be performed as part of the DC process. In that case, observations will be placed on the Observations Working File and either used or not used in the DC calculations as specified by the editing criteria.

Data to be edited must satisfy the station acronym, tracker type, object number, and ground transponder ID edit criteria and one of the three tracker type, mode, and rate combinations specified; the data must fall within the edit timespan and must not have been selected by another A or D card. Data selected and meeting these criteria will then be subjected to the frequency test before being accepted or deleted.

NOTES:

1. The Accept and Delete Specification cards must be preceded by an ACCREJ card. No more than 40 specification cards may appear in a single DCOPT or DMOPT subdeck.
2. For accept by tracker types, when the ALLX option is used, all stations with the same tracker type are used. For example, if ALL3 is input all stations with the last character of "3" or "A" will be used since their tracker types (5) are identical.
3. TDRS ID = SIC - 1299, where SIC = Support Identification Code (The TDRS ID should be the actual number contained in the 60-byte observation data for the forward link or the return link.)

4. Up to three combinations may be specified in columns 18-38. A single combination is given as TTMR.0, two combinations as TTMRTTMR.0, and three combinations as TTMRTTMRTTMR.0. Each combination must be represented by four digits. If the type is a single digit, it must be preceded by a zero. If type, mode, or rate editing is not to be performed, the appropriate position should be filled by a zero.

5. If the start time is equal to the end time, all other information on this card will be ignored. The editing will be treated as a single point edit, and all observations which occur at the single point edit time, regardless of tracker type, will be deleted.

6. If frequency for the Accept is by time (every Nth second), then set this field (columns 12 through 14) to -99 and follow with a 'SAMPLRTE' keyword card.

Table 4-1. Tracking System Associated With the Last Character of Tracker Acronyms

(The first two characters of the Tracker Acronym Are Not "DS")

VALUE OF X (LAST CHARACTER OF TRACKER ACRONYM)	TRACKING SYSTEM	TRACKING SYSTEM NUMBER
V	GRARR-VHF	1
M	MINITRACK	2
T, Q, F	C-BAND	3
G	GRARR S-BAND	4
3	USB MARK I OR SRE, N-S KEYHOLE (30-FOOT DISH)	5
8	USB MARK I OR SRE, E-W KEYHOLE (85-FOOT DISH)	6
A	USB MARK I OR SRE, E-W KEYHOLE (30-FOOT DISH)	6
X, Y, Z	SRE-VHF	7
R	ATSR	8
B[1]	ATSR GROUND TRANSPONDER	9
D	DSN	10
S	SR, N-S KEYHOLE (14-FOOT TWIN DISH)	11
L	LASER	12
C	OPTICAL	13
E, 4	X-Y PARABOLIC	14
K	TDRSS	15
J[1]	TDRSS GROUND TRANSPONDER	16
6	V&C	17

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[1]B AND J ARE NOT USED FOR DATA SELECTION.

Table 4-1. Tracking System Associated With the [illegible]
Character of Tracker Acronym

(The first two characters of the Tracker
Acronym Are "DS")

VALUE OF X (LAST CHARACTER OF TRACKER ACRONYM)	TRACKING SYSTEM	TRACKING SYSTEM NUMBER
6	DSN 26-METER USB	6
7	DSN 9-METER USB	8
OTHERWISE	DSN MARK IVA	10

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Table 4-2. Values of J and K

KIND OF TRACK	J \ K	0	1	2	3	4	5	6	7	8	9
DIRECT TO ATS-6	0	ATS-6			BORESITE						
	1	NIMBUS 6	GEOS-3	ASTP	BORESITE						
SATELLITE-TO-SATELLITE RELAY	2	GEOS-3	ASTP								
	3	NIMBUS 6									
GROUND RELAY	4	ROSB	AVEB	AGOB	BORESITE	GSFB	JSCB	MADB	ACNB	BURB	PR6B
	5	ROSB	AVEB	AGOB	BORESITE	GSFB	JSCB	MADB	ACNB	BURB	PR6B

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Table 4-3. Equipment Mode Indicators

Index Number \ Tracking System	C-Band	Minitrack	USB	ATSR	TDRS (Forward-Link Service, Return-Link Service)[1]
0	Any	Any	Any	Any	(Any, Any)
1	Beacon	Equatorial	Mark	Sidetone	(Forward-Link Service ≠ Return Link)[2]
2	Skin	Polar	SRE	Coherent	(MA, MA)
3				Satellite Phase-Locked-Loop Transponder	S-Band (SA1, SA1) or (SA2, SA2)
4				Satellite Crystal Transponder	S-Band (SA1, SA1)
5				Ground Crystal Transponder	S-Band (SA2, SA2)
6				Ground Phase-Locked-Loop Transponder	K-Band (SA1, SA1) or (SA2, SA2)
7					K-Band (SA1, SA1)
8					K-Band (SA2, SA2)

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[1]For one-way Doppler, only Return-Link Service is used.
For differenced one-way Doppler, interpret Forward-Link Service as compare Return-Link Service.

[2]Not applied to one-way Doppler.

Table 4-4. D :a Rate Indicators

INDEX NUMBER \ TRACKING SYSTEM	ATSR	GRARR	TDRSS
0	ANY	IY	ANY
1	1/SECOND	IECOND ESOLUTION 20)	≥ 40/MINUTE
2	2/SECOND	;ECOND ESOLUTION 20)	BETWEEN 40/MINUTE AND 9/MINUTE
3	4/SECOND	;ECOND ESOLUTION 20)	≤ 9/MINUTE
4	8/SECOND	ɅINUTE ESOLUTION 20)	
5	6/MINUTE	;ECOND ESOLUTION 100 OR 500)	
6		SECOND ESOLUTION 100 OR 500)	
7		3ECOND ESOLUTION 100 OR 500)	
8		ɅINUTE ESOLUTION 100 OR 500)	

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ACCREJ

- Card format (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	ACCREJ--keyword to activate the edit capability
9-11	I3	The total number of edit specification keyword cards (Aɓɓɓ**** and Dɓɓɓ****) to follow the ACCREJ keyword card
12-80		Blank

APOFOCAL

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: Ephemeris Generation (EPHEM), DC
- Detailed format:

Columns	Format	Description
1-8	A8	APOFOCAL--keyword to set the sectioning indicator for crossing at the apofocal point
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Apofocal crossing indicator for Section I
39-59	G21.14	Apofocal crossing indicator for Section J
60-80	G21.14	Apofocal crossing indicator for Section K

Unless an APOFOCAL keyword card is included in the input deck, sectioning will not occur at the apofocal point. If an APOFOCAL card is included, the apofocal crossing indicators are interpreted in the following fashion:

= 1.0, section change at apofocal point (default)

= 2.0, do not change section at apofocal point

ATMOSDEN

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	ATMOSDEN--keyword for reading an entire atmospheric density table in the GTDS or the DODS format and specifying the density model
9-11	I3	Density table entry number (0, 1, 2, ..., 60); 0 indicates no density table
12-14	I3	For the Harris-Priester atmospheric density model, the atmospheric density table in the DODS format (punch any integer value; see Note) For the Jacchia-Roberts model, print the working file report: = 1, yes = 2, no (default)
15-17	I3	Atmospheric density model: = 1, Jacchia-Roberts = 2, Harris-Priester (default)
18-38	G21.14	Height (kilometers)
39-59	G21.14	Minimum density at height (kilograms per kilometer^3)
60-80	G21.14	Maximum density at height (kilograms per kilometer^3)

This keyword has two purposes: to specify the density model and to supply a density table for the Harris-Priester density model, thereby overriding the default atmospheric density table. The Jacchia-Roberts density model is specified by entering a value of 1 in the third integer field of the ATMOSDEN keyword card. Since the

Jacchia-Roberts model does not use an atmospheric density table, no additional data are needed on the card.

When using the Harris-Priester atmospheric density model, multiple ATMOSDEN keyword cards must be supplied. Each card specifies a row of the Harris-Priester density table, which has a maximum of 60 rows. The DODS units for minimum and maximum densities (grams per kilometer^3) are converted internally to kilograms per kilometer^3.

NOTE: Density table input in the DODS format is specified with any punch in this field. The formats are given on the following pages. The first card in the DODS deck specifies the number of density data cards, to a maximum of 60 cards.

Atmospheric Density Table (DODS Format)

First card: I3

All other cards: 17X, 3(G21.14)

COLUMNS						
1 ——— 8	9—11	12—14	15—17	18———38	39———59	60———80
ATMOSDEN	1 0	1	2			
0 1 0						
				0.0 D+00	1.2250000D+09	1.2250000D+09
				1.0 D+01	4.9740000D+02	4.9740000D+02
				1.5 D+02	2.1280000D+00	2.2210000D+00
				2.0 D+02	3.2300000D−01	3.7610000D−01
				2.5 D+02	8.9760000D−02	1.2620000D−01
				3.0 D+02	3.1640000D−02	6.4390000D−02
				4.0 D+02	6.4870000D−03	1.4170000D−02
				5.0 D+02	1.2610000D−03	4.6200000D−03
				6.0 D+02	3.2940000D−04	1.7220000D−03
				7.0 D+02	9.6310000D−06	7.0000000D−04

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Atmospheric Density Table (GTDS Format)

COLUMNS 1——8	9—11	18——38	39——59	60——80
ATMOSDEN	1	0.0	1.2250000D+09	1.2250000D+09
ATMOSDEN	2	4.0000D+01	3.9957000D+06	3.9957000D+06
ATMOSDEN	3	1.0000D+02	4.9740000D+02	4.9740000D+02
ATMOSDEN	4	1.5000D+02	2.1110000D+00	2.2020000D+00
ATMOSDEN	5	2.0000D+02	2.2430000D−01	2.8890000D−01
ATMOSDEN	6	2.5000D+02	4.4780000D−02	7.9130000D−02
ATMOSDEN	7	3.0000D+02	1.2310000D−02	2.8090000D−02
ATMOSDEN	8	4.0000D+02	1.3970000D−03	5.3760000D−03
ATMOSDEN	9	5.0000D+02	2.1660000D−04	1.3460000D−03
ATMOSDEN	10	6.0000D+02	4.0470000D−05	3.8380000D−04
ATMOSDEN	11	8.0000D+02	4.1430000D−06	4.1700000D−05
ATMOSDEN	12	1.0000D+03	1.5100000D−06	8.4000000D−06

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ATMOSEDT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	ATMOSEDT - Keyword to set the atmospheric editing switch and limits
9-11	I3	Atmospheric editing switch = 0, edit (default) ≠ 0, do not edit
12-17		Blank
18-38	G21.14	Minimum ray path height to be accepted (kilometers) (500 kilometers default)
39-59	G21.14	Maximum central angle to be accepted (degrees) (70 degrees default)
60-80		Blank

Atmospheric editing is available for TDRSS and ATSR SST tracking data only.

ATMOSRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: Permanent File Report Generation (FILERPT), EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	ATMOSRPT--keyword to specify a report of the Atmospheric Density Models File
9-11	I3	Type of file: = 1, Harris-Priester = 2, Jacchia-Roberts
12-14	I3	Summary report: = 0, no = 1, yes
15-17	I3	Specific model reports: = 0, no = n, ($1 \leq n \leq 10$) implies print model number n (See Appendix D, Item E, for specific model numbers.) = 10, print all 10 models
18-80		Blank

Two ATMOSRPT cards are allowed per PFROPT subdeck.

ATTANG1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, Data Simulation (DATASIM)
- Detailed format:

Columns	Format	Description
1-8	A8	ATTANG1--keyword to set coefficients of a function what describes right ascension or yaw angle of the spin axis. The function can be a polynomial or polynomial with trigonometric terms (see Note 1).
9-11	I3	Number of coefficients describing the function
12-14	.	Flight Section I (optional)
15-17	I3	Right ascension/yaw angle switch (see Note 2): = 1, right ascension coefficients = 2, yaw angle coefficients
18-38	G21.14	Coefficient of constant term (C_1)
39-59	G21.14	Coefficient of first-order term (C_2)
60-80	G21.14	Coefficient of second order or amplitude of sinusoid (C_3)

For a polynomial with order greater than 2, or to specify further trigonometric coefficients, a second ATTANG1 keyword card containing the remaining coefficients must be provided. The coefficient of a third-order term or angular frequency (C_4) is entered in the first real field in columns 18 through 38. The coefficient of a fourth-order term or phase (C_5) is entered in the second real field in columns 39 through 59. Columns 1 through 17 and 60 through 80 remain blank.

If ATTANG1 and ATTANG2 keyword cards are used to specify the thrust axis, they should be input as follows:

1. If the thrust axis direction remains constant, use the right ascension and declination options on the ATTANG1 and ATTANG2 keyword cards and enter only the constant term coefficients (C_1) for right ascension and declination.

2. If the thrust axis direction changes in the inertial frame, use the right ascension and declination options on the ATTANG1 and ATTANG2 keyword cards and enter the C_1 constant coefficients plus whatever C_n ($n > 1$) coefficients are necessary to describe the change in thrust axis orientation with respect to the inertial frame. This option is especially useful for a satellite whose thrust axis is directed along the spin axis.

3. If the thrust axis is directed along the satellite velocity vector, use the yaw and pitch options on the ATTANG1 and ATTANG2 keyword cards and leave all other fields on the keyword card blank. This option is especially useful for three-axis-stabilized spacecraft.

4. If the thrust axis is directed at a constant angle with respect to the velocity vector, use the yaw and pitch options on the ATTANG1 and ATTANG2 keyword cards and enter the constant coefficients (C_1) to describe the angle with respect to the velocity vector along which the thrust axis is directed. This option is probably most useful for thrust directed antiparallel to the velocity vector (C_1 = 180 degrees).

5. If the thrust axis direction changes in reference to orbital frame, use the yaw and pitch options on the ATTANG1 and ATTANG2 keyword cards and enter the C_1 constant coefficients plus whatever C_n ($n>1$) coefficients are necessary to describe the change in thrust axis orientation with respect to the orbital frame.

NOTES: 1. The polynomial is of the form

$$= C_1 + C_2t + C_3t^2 + C_4t^3 + C_5t^4$$

The polynomial function with trigonometric terms is of the form

$$= C_1 + C_2t + C_3\sin(C_4t + C_5)$$

Its value is in degrees and the value of t is in seconds. When modeling the attitude in the force model, the first equation is always implied.

If this card is used to model landmark (spinning) data, the second equation is implied. If this card is used to model landmark (three-axis) data, the function is specified on the ATTANG3 card.

2. If this card is being used to model landmark (spinning) data or attitude sensor data, the right ascension is assumed to be input. If this card is being used to process landmark (three-axis) data, the yaw angle is assumed to be defined with respect to a geocentric frame. For modeling the attitude in the force model, the user has a choice of right ascension or yaw.

ATTANG2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	ATTANG2--keyword to set coefficients of a function which describes the declination or pitch angle of the spin axis. The function can be a polynomial or a polynomial with trigonometric terms (see Note 1)
9-11	I3	Number of coefficients describing the function
12-14		Flight Section I (optional)
15-17	I3	Declination/pitch angle switch (see Note 2): = 1, declination coefficients = 2, pitch angle coefficients
18-38	G21.14	Coefficient of constant term (b_1)
39-59	G21.14	Coefficient of first-order term (b_2)
60-80	G21.14	Coefficient of second-order term or amplitude of sinusoid (b_3)

For a polynomial of order greater than 2, or to specify further trigonometric coefficients, a second card containing the remaining coefficients must be provided. The coefficient of a third-order term or angular frequency (b_4) is entered in the first real field in columns 18 through 38. The coefficient of a fourth-order term or phase (b_5) is entered in the second real field in columns 39 through 59. Columns 1 through 17 and 60 through 80 remain blank.

If ATTANG1 and ATTANG2 keyword cards are used to specify the thrust axis, they should be input as follows:

1. If the thrust axis direction remains constant, use the right ascension and declination options on the ATTANG1 and ATTANG2 keyword cards and enter only the constant term coefficients (b_1) for right ascension and declination.

2. If the thrust axis direction changes in reference to the inertial frame, use the right ascension and declination options on the ATTANG1 and ATTANG2 keyword cards and enter the b_1 constant coefficients plus whatever b_n ($n > 1$) coefficients are necessary to describe the change in thrust axis orientation with respect to the inertial frame. This option is especially useful for a satellite whose thrust axis is directed along the spin axis.

3. If the thrust axis is directed along the satellite velocity vector, use the yaw and pitch options on the ATTANG1 and ATTANG2 keyword cards and leave all other fields on the keyword card blank. This option is especially useful for three-axis-stabilized spacecraft.

4. If the thrust axis is directed at a constant angle with respect to the velocity vector, use the yaw and pitch options on the ATTANG1 and ATTANG2 keyword cards and enter the constant coefficients (b_1) to describe the angle with respect to the velocity vector along which the thrust axis is directed. This option is probably most useful for thrust directed antiparallel to the velocity vector (b_1 = 180 degrees).

5. If the thrust axis direction changes in reference to orbital frame, use the yaw and pitch options on the ATTANG1 and ATTANG2 keyword cards and enter the b_1 constant coefficients plus whatever b_n $(n>1)$ coefficients are necessary to describe the change in thrust axis orientation with respect to the orbital frame.

NOTES: 1. The polynomial is of the form

$$b_1 + b_2 t + b_3 t^2 + b_4 t^3 + b_5 t^4$$

The polynomial function with trigonometric terms is of the form

$$= b_1 + b_2 t + b_3 \sin(b_4 t + b_5)$$

Its value is in degrees and the value of t is in seconds. When modeling the attitude in the force model, the first equation is always implied.

If this card is used to model landmark (spinning) data, the second equation is implied. If this card is used to model landmark (three-axis) data, the funtion is specified on the ATTANG3 card.

2. If this card is being used to model landmark (spinning) data or attitude sensor data, the right ascension is assumed to be input. If this card is being used to process landmark (three-axis) data, the yaw angle is assumed to be defined with respect to a geocentric frame. For modeling the attitude in the force model, the user has a choice of right ascension or yaw.

ATTANG3

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	ATTANG3--keyword to set coefficients of a function which describes the roll angle. The function can be a polynomial or polynomial with trigonometric terms (see Note).
9-11	I3	Number of coefficients
12-14		Blank
15-17	I3	Polynomial/polynomial-with-trigonometric-terms switch for modeling landmark (three-axis) data: = 1, use polynomial model = 2, use polynomial-with-trigonometric-terms model This applies to all three attitude angles: roll, pitch, and yaw.
18-38	G21.14	Coefficient of constant term (d_1)
39-59	G21.14	Coefficient of first-order term (d_2)
60-80	G21.14	Coefficient of second-order term or amplitude of sinusoid (d_3)

For a polynomial of order greater than 2, or to specify further trigonometric coefficients, a second card containing the remaining coefficients must be provided. The coefficient of a third-order term or angular frequency (d_4) is entered in the first real field in columns 18 through 38. The coefficient of a fourth-order term or phase (d_5) is entered in the second real field in columns 39 through 59. Columns 1 through 17 and 60 through 80 remain blank.

NOTE: The polynomial is of the form

$$R = d_1 + d_2t + d_3t^2 + d_4t^3 + d_5t^4$$

The polynomial function with trigonometric terms is of the form

$$R = d_1 + d_2t + d_3\sin(d_4 + d_5)$$

ATTPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	ATTPAR--keyword to specify number of attitude coefficients to be solved for
9-11	I3	Total number of right ascension (or yaw) polynomial coefficients to be solved for (Corresponding partial derivatives for these parameters are computed.)
12-14	I3	Total number of declination (or pitch) polynomial coefficients to be solved for (Corresponding partial derivatives for these parameters are computed.)
15-17	I3	Total number of roll polynomial coefficients to be solved for (Corresponding partial derivatives for these parameters, which are used only with landmark data from an Earth-stabilized satellite, are computed.)
18-80		Blank

In an EPHEM Program run, only the computation of the right ascension and declination partial derivatives can be specified. When ATTPAR is used to solve for the attitude in the thrust force model, only the right ascension and declination coefficients can be solved for.

When right ascension or declination partial derivatives are to be computed in a thrust run, the user must specify some nonzero value of thrust acceleration via the THRSTCOF keyword; otherwise, all partial derivatives will be zero. Also, when right ascension and/or declination are to be solved for in a DC Program run, only one flight section covering the entire observation timespan is allowed.

AUTOFORC

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	AUTOFORC--keyword that allows for inclusion of resonance potentials
9-11	I3	= 1, include resonance potentials = 2, do not include resonance potentials (default)
12-80		Blank

AVERAGE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	AVERAGE--keyword to set Variation of Parameters (VOP) numerical averaging
9-11	I3	= 1, compute an individual quadrature for drag = 2, do not compute an individual quadrature for drag (default)
12-14	I3	= 1, compute an individual quadrature for solar radiation pressure = 2, do not compute an individual quadrature for solar radiation pressure (default)
15-17		Blank
18-38	G21.14	Quadrature order for continuous perturbations (see Note)
39-59	G21.14	Quadrature order for drag (see Note)
60-80	G21.14	Quadrature order for solar radiation pressure (see Note)

NOTE: Acceptable quadrature order values are 6, 9, 12, 16, and 24. The default value is 24.

BDROTATE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	BDROTATE--keyword to set body rotation rates
9-11	I3	Index of body I (see Note)
12-14	I3	Index of body J (see Note)
15-17	I3	Index of body K (see Note)
18-38	G21.14	Rotation rate of body I (degrees per second)
39-59	G21.14	Rotation rate of body J (degrees per second)
60-80	G21.14	Rotation rate of body K (degrees per second)

The valid body indexes are

1 = Earth	5 = Jupiter	9 = Pluto
2 = Moon	6 = Saturn	10 = Mercury
3 = Sun	7 = Uranus	11 = Venus
4 = Mars	8 = Neptune	

NOTE: A zero index is ignored. The maximum index is 11. Use multiple BDROTATE cards for more than three bodies.

BODYRAD

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	BODYRAD--keyword to set equatorial radii for specified body
9-11	I3	Index of body I (see Note)
12-14	I3	Index of body J (see Note)
15-17	I3	Index of body K (see Note)
18-38	G21.14	Mean equatorial radius of body I (kilometers)
39-59	G21.14	Mean equatorial radius of body J (kilometers)
60-80	G21.14	Mean equatorial radius of body K (kilometers)

The valid body indexes are

1 = Earth	5 = Jupiter	9 = Pluto
2 = Moon	6 = Saturn	10 = Mercury
3 = Sun	7 = Uranus	11 = Venus
4 = Mars	8 = Neptune	

NOTE: A zero index is ignored. The maximum index is 11. Use multiple BODYRAD cards for more than three bodies.

BURNFSF

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	BURNFSF--keyword to set the option of orbit propagation through burns using information from the FSF
9-11	I3	FSF option: 1 = use information from FSF 2 = do not use information from FSF (default)
12-80	--	Blank

NOTES:

1. Using option 1 in this keyword card will cause information provided by all other OGOPT keyword cards to be overridden by that of the FSF.
2. Before using option 1, be sure that all flight section parameters related to this satellite specified in FSF have been entered or updated by THMODEL Program (for thrust coefficients) and by user via UI panels (for all other information).

CBODY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	CBODY--keyword to set the integration central body by flight section (see Note 1)
9-11	I3	Flight section I (see Note 2)
12-14	I3	Flight section J (see Note 2)
15-17	I3	Flight section K (see Note 2)
18-38	G21.14	Body number for section I
39-59	G21.14	Body number for section J
60-80	G21.14	Body number for section K

The valid body indexes are

1 = Earth	5 = Jupiter	9 = Pluto
2 = Moon	6 = Saturn	10 = Mercury
3 = Sun	7 = Uranus	11 = Venus
4 = Mars	8 = Neptune	

NOTES:
1. Potential field data for both the Earth and the Moon must be included via POTFIELD keyword cards whenever this keyword card is used.
2. The maximum number of flight sections is 10. Use multiple CBODY cards for more than three sections.

CHWT****

- Card format: (A8, 3I3, 3G21.14)
- Application programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	CHWT****--keyword to input noise standard deviations for observations in 60-byte format when the SOR is requested, or to input noise standard deviations for observations tracking a particular ground transponder for both SOR and non-SOR runs. A maximum of 15 cards is allowed. The asterisks represent the acronym of a station for which the input noise standard deviations will apply. If no station acronym is specified, the input noise standard deviation will apply to all stations. (See Note 1.)
9-11	I3	Observation type number (see Appendix A, Table A-2), with the following exceptions: = 11, XY parabolic X85 = 12, XY parabolic Y85 = 17, SRE X14 = 18, SRE Y14 = 42, ATSR sidetone range
12-14	I3	Tracker type number (see Table 4-1), with the following exceptions: = 4, SRE X14 and Y14 = 5, SRE X30 and Y30; = 6, SRE X85 and Y85 = 11, URAN and URDF
15-17	I3	For the equipment mode indicator (applies only to minitrack data and ATSR relay data): = 0, minitrack equatorial mode = 1, minitrack polar mode = 2, satellite flag at review (PLL) mode = 3, satellite crystal mode = 4, ground crystal mode = 5, ground PLL mode

Columns	Format	Description
15-17 (Cont'd)		For the frequency band indicator (applies to TDRSS one-way or two-way Doppler data from user spacecraft but not to user ground transponders): = 1, S-band = 2, K-band For the multiple access indicator (applies to TDRSS beam angles): = 1, single access (or undefined) = 2, multiple access TDRSS ground transponder index (if observation type in column 11 is 82, 83, 88, 89, 90, 91) = 0, means all ground transponders
18-38	G21.14	Data rate indicator: For ATSR range-rate data (sidetone, coherent, and ground relay mode): = 0, data rate does not equal six observations per minute = 4, data rate equals six observations per minute For other ATSR data types: = 0, for all data types For TDRSS Doppler data (two-way, hybrid, differenced one-way Doppler from ground transponder but not user spacecraft): = 1, for data rates greater than observations per minute (Δt less than 1.5 seconds per observation) = 2, for data rates less than or equal to 40 observations per minute but greater than 9.23 observations per minute (Δt greater than or equal to 1.5 seconds but less than 6.5 seconds per observation) = 3, for data rates less than or equal to 9.23 observations per minute (Δt greater than or equal to 6.5 seconds per observation) For other TDRSS data types, = 0, for all data rates

Columns	Format	Description
39-59		Blank
60-80	G21.14	Noise standard deviation--units used are meters for range, centimeters per second for range rate, hertz for ATSR coherent and relay range rate, seconds of arc for angles, and cosine values for minitrack angles (see Appendix A, Table A-4)

NOTES: 1. The CHWT card is ignored if SOR is not requested unless user inputs noise standard deviations for a particular ground transponder. If no SOR is requested, GTDS ignores the station acronym input by the user; consequently the user should take care to avoid using conflicting CHWT keyword cards.

For ground transponder noise standard deviation override, 15 must be placed in columns 13 through 14.

2. Use of the station acronym or ground transponder index number on this keyword card may result in the formation of one additional SOR category than would otherwise be formed, for each such keyword card present in the input deck. Also, SOR categories thus formed cannot be mixed with other SOR categories using the MIXPAIR keyword card.

CMCORR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	CMCORR--keyword to set antenna offsets from spacecraft center of mass
9-11	I3	Station Type[1]: = 15, TDRSS = 17, SGLS
12-14	I3	Blank
15-17	I3	Blank
18-38	G21.14	x-component of the antenna offset (meters)[2]
39-59	G21.14	y-component of the antenna offset (meters)[2]
60-80	G21.14	z-component of the antenna offset (meters)[2]

NOTES: 1. One card is required for each station type

2. Offsets are expressed in the following Orbit Plane coordinate frame:

x_{op}-axis = Radius vector from center of Earth to the spacecraft

y_{op}-axis = In the orbital plane, 90 degrees ahead of the spacecraft in the sense of the motion

z_{op}-axis = Direction along the angular momentum vector, r x r

CMPEPHEM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: Ephemeris Comparison (COMPARE)
- Detailed format:

Columns	Format	Description
1-8	A8	CMPEPHEM--keyword to specify the COMPARE Program parameters
9-11	I3	Output options: = 1, position differences = 2, position and velocity differences = 3, world map
12-14	I3	Primary input file type--input a packed word IJK where I is the file type indicator: = -, two ORBIT File levels with the same FRN = 0, ORBIT File = 1, ORB1 File = 2, EPHEM File J is the level indicator for the ORBIT File: = 0, sequential = 1 to 9, ORBIT File level K is the partial derivative switch for the ORBIT File: = 1, with partial derivatives = 2, without partial derivatives
15-17	I3	Secondary input file type (specified the same as the primary file)
18-38	G21.14	Start time of the comparison (yymmddhhmmss.ssss)
39-59	G21.14	End time of the comparison (yymmddhhmmss.ssss)
60-80	G21.14	Comparison interval in seconds (see Note)

NOTE: For the ORBIT File, if no value is specified for the comparison interval, the program sets the comparison interval to 60 seconds.

For EPHEM or ORB1 Files, if no value is specified for the comparison interval, the comparison interval is computed as the smallest existing interval between points common to both files (e.g., for two files generated with 6-second and 9-second intervals, the comparison interval would be 18 seconds). A user-supplied interval can be greater than or equal to 1 second but must be exactly compatible with the intervals on both input files.

CMPFILES

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	CMPFILES--keyword to select FORTRAN unit number of two EPHEM Files to be compared
9-11	I3	EPHEM File unit number, options are 24, 81, 83, 85, 87 (default = 24)
12-14	I3	EPHEM File UNIT number, options are 24, 81, 83, 85, 87 (default = 81)
15-17	I3	Variable-stepsize EPHEM Comparison Switch = 1, Compare at matched times = 2, Compare at constant stepsize = 3, Compare at interpolated times
18-80		Blanks

CMPPLOT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	CMPPLOT--keyword which sets the COMPARE Program printer plot options (see Note 1)
9-11	I3	Sum of desired plot types (see Note 2)
12-17		Blank
18-38	G21.14	Minimum ordinate (y) scale value for plots with unit specified in columns 60 through 80 (see Note 3)
39-59	G21.14	Maximum ordinate (y) scale value for plots with unit specified in columns 60 through 80 (see Note 3)
60-80	G21.14	Units for y scale (see Note 4): = 1.0, kilometers or kilometers per second = 2.0, meters or meters per second = 3.0, centimeters or centimeters per second

NOTES: 1. The following JCL cards are required when printer plots are requested:

```
//GO.FT42F001    DD    DSN=SSPLOT,
//    UNIT=3350,DISP=(,PASS),SPACE=(CYL,(5,1),RLSE)
//    DCB=(RECFM=VBS,LRECL=136,BLKSIZE=5308,
//    BUFNO=1)
```

2. Available plot types and their codes:
Track-oriented position differences = 1
Track-oriented velocity differences = 2
Cartesian position differences = 4
Cartesian velocity differences = 8

Any combination of these plots may be obtained by requesting the sum of the desired codes (i.e., track-oriented position differences + track-oriented velocity differences = 3).

3. These scale values will be applied to all plots. If the fields are blank, each plotted variable will automatically be scaled to its own range.

4. The y-scale units must be specified whenever columns 18 through 38 or 39 through 59 are nonzero.

CMPTITLE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	CMPTITLE--keyword to specify the number of title cards for COMPARE Program printer plots
9-11	I3	Number of title cards to immediately follow this card (must be 1, 2, or 3; default = 3)
12-80		Blank

The CMPTITLE card indicates that the next one, two, or three cards are to be treated as user titles for the COMPARE printer plots. If the input number of title cards is less than 1 or greater than 3, a default value of 3 is assigned and a warning message is printed.

If a card having the characters "END" in columns 1 through 3 is encountered, it is treated as an end-of-subdeck card. The next card is treated as a keyword card.

The title cards are read in 7A8 format. All three title cards will be reproduced below each chart.

CNM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	CNM--keyword that sets $C_{n,m}$ harmonic coefficient options and values
9-11	I3	Harmonic options: = 1, compute partial derivatives of state with respect to a specified harmonic using the default value = 2, use the value in columns 18-38 and compute partial derivatives instead of the default value = 3, use the value in columns 18-38 instead of the default value
12-14	I3	N coefficient (maximum of 21)
15-17	I3	M coefficient (maximum of 21)
18-38	G21.14	Value of $C_{n,m}$
39-59	G21.14	A priori standard deviation of $C_{n,m}$
60-80	G21.14	Central body number of input harmonic coefficent: = 1.0, Earth = 2.0, Moon

In a DC Program run, the option to compute partial derivatives indicates that the harmonic coefficients will be solved for using either the default value or the input value as the a priori estimate and the priori standard deviation in columns 39 through 59.

Keyword card CNM is also used to define individual $C_{n,m}$ coefficients. To change an entire harmonic field, see the HARMONIC keyword card. To compute a partial derivative with respect to a specific $C_{n,m}$ or $S_{n,m}$, the specific harmonic

coefficient must be used in the force model (see Reference 2, Section 4.3).

COMPOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	COMPOPT--keyword to indicate the beginning of the COMPOPT subdeck
9-80		Blank

The COMPOPT subdeck can contain the following optional keywords cards:

CMPEPHEM
CMPFILES
CMPPLOT
CMPTITLE
EPHMERGE
HISTPLOT
HSTSCALE

The COMPOPT subdeck must terminate with the END keyword card.

CONSIDER

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	CONSIDER--keyword to invoke the consider mode
9-11	I3	Frequency at which the consider mode is used after the first consider iteration (default = 1)
12-14	I3	The first iteration in which to employ the consider mode (default = 0)
15-80		Blank

When using the consider mode (i.e., using consider parameters), state variables are the only parameters which will be solved. All other variables listed as unknowns will be included as consider variables.

CONSTRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: Permanent File Report Generation (FILERPT), EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	CONSTRPT--keyword to specify a report of the Astrodynamic Constants File
9-11	I3	Type of report: = 0, summary = 1, partial = 2, full
12-14	I3	Number of bodies (see Appendix B): = 0, all > 0, body number
15-17	I3	Model number (see Appendix D, Item C): = 0, all models > 0, model number
18-80		Blank

This card may only be included once per PFROPT subdeck.

CONTROL

- Card format: (A8, 2X, A8, 2X, A8, 1X, I1, 3 (A8, 2X), A8, I2, 1X, I7)
- Applicable programs: EPHEM, DC, EARLYORB, DATASIM, ANALYSIS, COMPARE, DATAMGT, FILERPT
- Detailed format:

Columns	Format	Description
1-8	A8	CONTROL--keyword which initiates the input processor
9-10		Blank
11-18	A8	Identifies which of the following programs is to be run: EPHEM ANALYSIS DC COMPARE EARLYORB DATAMGT DATASIM FILERPT The program identifier must be left justified (no default).
19-20		Blank
21-28	A8	Indicates DODS real-time observation handling (not supported). This field should be blank.
29		Blank
30		60-byte data base indicator for using old/new formatted data base. = blank, default (new format) = 1, old format
31-38	A8	Indicates whether or not input card images are to be printed: = blank (default), print all card images = NO-PRINT, print only erroneous card images
39-40		Blank

Columns	Format	Description
41-48	A8	Indicates whether or not elements and epoch are to be passed through block COMMON from a previous program execution: Blank (default) = not passed INPUT = pass initial values from preceding program execution OUTPUT = pass final values from preceding program execution TDROUTDC = pass final TDRS values from preceding TDRSS DC program execution The element source indicator must be left justified. If the output option is used (for EPHEM to EPHEM) and the elements being passed are in the true-of-date coordinate system, they will be input with a true-of-reference title.
49-50		Blank
51-58	A8	Indicates whether or not block COMMON values are to be restored to initial values: Blank (default) = do not restore Nonblank (any character) = restore
59-60		Blank
61-68	A8	Specifies satellite alphanumeric name
69-70	I2	Controls system traceback error printout: Blank or zero (default) = default to OS control = -1, do not print any traceback error messages; do not terminate run for traceback error types 210 through 300 = nn (nn > 0), print any traceback error message nn times but do not terminate run
71		Blank
72-78	I7	Indicates number by which satellite is identified, usually the seven-digit international designator. (If fewer

Columns	Format	Description
72-78 (Cont'd)		than seven digits are used, this number must be right justified.) This will be the user satellite number when the TDRSS processing capability is invoked.
79-80		Blank

The CONTROL card must be the first card in each program input deck. The COMMON restore option and the element source specification are mutually exclusive.

CONVERG

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	CONVERG--keyword to set the DC iteration control
9-11	I3	Maximum number of iterations allowed where n 0 (default = 15) = -1, compute residuals for first iteration only, no solve parameter computations will be performed (see following page)
12-14	I3	Maximum number of consecutive divergent iterations allowed (default = 3)
15-17	I3	Indicator for how to process the DC Program if the product of the normal matrix and its inverse exceeds the tolerance: = 0, do not compute the eigenvalues and eigenvectors of the normal matrix; continue DC Program (default) = 1, compute the eigenvalues and eigenvectors; continue DC Program = 2, compute the eigenvalues and eigenvectors; stop DC Program if one or more of the eigenvalues are less than 0.5D-16
18-38	G21.14	Iteration covergence criterion (see Note; default = 1.0D-4)
39-59	G21.14	Minimum RMS for DC termination (default = 3.0D-6)
60-80	G21.14	Tolerance for the product of the normal matrix and its inverse (default = 1.0D0)

NOTE: The primary test for convergence is given by

$$\left| \frac{RMS_B - RMS_p}{RMS_B} \right| < \varepsilon$$

where RMS_P is the predicted rms, RMS_B is the smallest rms, and is the iteration convergence criterion.

A secondary test for DC termination is defined as

$$RMS_i \leq RMSMIN$$

where RMSMIN is the minimum RMS for DC termination. (See Section 3.2.1.17 for a discussion of DC termination criteria.)

A capability of the DC program is the O-C run, which may be used for analysis of the observation data on the observation working file for a given DC run. After initialization, the first DC iteration is carried through orbit propagation and computation of the residuals. The DC process is then terminated and SOR processing is done if requested. An O-C run will be initiated with a -1 in columns 9 through 11 on the CONVERG keyword card.

The following are not allowed in an O-C run:

1. Solve parameters. If any are requested, by keyword cards or by default, a message will appear before the Initial Conditions Report with the parameter and its reset value.

2. DCOPT ACC/REJ card other than a "D" in column 1 and followed by either 79 blanks or the times covering the DMOPT data interval. If any other ACC/REJ cards are present, a message will be printed after the DCOPT keyword card images.

3. SOR request other than for input vector only. If any other request is made, it is overridden to indicate "SOR on input vector only," and a message will be printed before the Initial Conditions Report.

COVARNC

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	COVARNC--keyword to set the upper triangle of the a priori state covariance matrix
9-11	I3	Packed row-and-column integer for element I
12-14	I3	Packed row-and-column integer for element J
15-17	I3	Packed row-and-column integer for element K
18-38	G21.14	Matrix element I
39-59	G21.14	Matrix element J
60-80	G21.14	Matrix element K

The packed row-and-column integer is given by multiplying 10 by the row number plus the column number. For example, the row and column integer for row 1 and column 2 is 12. The row number must be less than or equal to the column number because only the upper triangle of the symmetric matrix is input. Because the covariance matrix is 6 by 6, the maximum packed value is 66, indicating the sixth row and sixth column. The covariance matrix is symmetric, and a lower triangle element will be stored as an upper triangle element with a corresponding switching of the row and column. If values of the matrix are not input, default values will be used.

This matrix is used in the DC process as the a priori covariance matrix of the state. When used with an EPHEM Program run and the matrix map option, it will be mapped to another epoch.

CWEIGHT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	CWEIGHT--keyword to set observation weighting factor constants for observation handling (see note)
9-11	I3	Weighting factor index I
12-14	I3	Weighting factor index J
15-17	I3	Weighting factor index K
18-38	G21.14	Weighting factor as specified for index I (C_i)
39-59	G21.14	Weighting factor as specified for index J (C_j)
60-80	G21.14	Weighting factor as specified for index K (C_k)

Weighting Factor Index	Description	Symbol	Default Values
1	Elevation angle gain for range, elevation, and range-rate weighting factor	(C_1)	0.0
2	Bias factor for range, elevation, and range-rate weighting factor	(C_2)	1.0
3	Elevation angle gain for azimuth angle weighting factor	(C_3)	1.0
4	Bias factor for azimuth angle weighting factor	(C_4)	0.0
5	Multiplier for observation noise variance in weight computation	(C_5)	1.0
6	Multiplier for the a priori observation variance obtained from the preprocessor	(C_6)	0.0

NOTE: Observation weight: $W = \rho_F/\sigma^2$

where for observation types 1, 5, 9 $\rho_F = C_1 \sin E + C_2$

for observation type 4 $\rho_F = C_3 \cos E + C_4$ E = elevation angle

for observation types 2, 3 $\rho_F = 1 - O_c^2$ O_c = calculated observation

for observation types 6, 7, 8, and all observa- types greater than 9 pF = 1.0

and $\sigma^2 = C_5\sigma_1^2 + C_6\sigma_2^2$, where σ_1^2 is the a priori variance of the observation noise which can be set by the OBSDEV or CHWT**** keyword. σ_2^2 is the a priori variance obtained from the observation preprocessor.

DƀƀƀΣ****

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	DƀƀƀΣ****--keyword to set edit deletion criteria where the asterisks represent the receive (tracking station) acronym (see Note 1). (See Appendix A, Table A-5, for the 60-byte data base station acronyms.) If all receive stations employing the same tracker type are to be deleted, "ALLX" is used instead of a station acronym, where X specifies the tracker type (see Table 4-1, Page 4-8, for values of X). If all receive stations are to be deleted, it is not necessary to input the station acronym or tracker type (see Note 2).
9-11	I3	Satellite object number: For the USB tracking system = the object number For the ATS tracking system = the packed integer IJK: I = relay satellite indicator (e.g., I = 6 for ATS-6) (See Table 4-2, Page 4-9, for values of J and K.) For the TDRS tracking system = the packed integer IJK: I = Vehicle Identification Code (VIC) of target for satellite-to-satellite data, or VIC of return-link TDRS for ground transponder data (see Note 3). J = forward-link TDRS ID (see Note 3) K = return-link TDRS ID (If I or J or K = 0, do not key on this item.) Default = 0, delete all object numbers

Columns	Format	Description
12-14	I3	Frequency at which observations satisfying criteria for the Delete Specification card are deleted (default = 1)
15-17	I3	Ground transponder index number (for the TDRS tracking system = the ground transponder index number to be deleted) Default = 0, deletes all ground transponder index numbers
18-38	G21.14	Editing on a combination of specifications TTMR (see Note 4): TT = GTDS observation type number (see Appendix A, Table A-2) = 00, do not key on observation type M = mode indicator as defined for for C-band, minitrack, USB, ATSR, Cartesian vector, and TDRS tracking systems (see Table 4-3, Page 4-10, for values.) = 0, do not key on mode R = data rate indicator for GRARR, ATSR, and TDRS tracking systems (See Table 4-4, Page 4-11, for values.) = 0, do not key on data rate
39-59	G21.14	Start time of span for edit (yymmddhhmmss.ssss); default is the time of the earliest observation (see Note 5).
60-80	G21.14	End time of span for edit (yymmddhhmmss.ssss); default is the time of the last observation (see Note 5).

This keyword may be included in either the DMOPT or the DCOPT subdeck, depending on when the user wants the editing to be performed. By placing the keyword in the DMOPT subdeck, the editing will be performed as the observations working file is being built. Thus, the edited observation

will not appear in the working file. By placing the keyword in the DCOPT subdeck, editing will be performed as part of the DC process. In that case, observations will be placed on the observations working file and either used or not used in the DC calculations as specified by the editing criteria.

Data to be edited must satisfy the station acronym, tracker type, object number, and ground transponder ID edit criteria and <u>one</u> of the three tracker type, mode, and rate combinations specified; must fall within the edit timespan; and must not have been selected by another A or D card. Data selected and meeting these criteria will then be subjected to the frequency test before being accepted or deleted.

<u>NOTES</u>:

1. The Accept and Delete Specification cards must be preceded by an ACCREJ card. No more than 40 specification cards may appear in a single DCOPT or DMOPT subdeck.

2. For delete by tracker types, when the ALLX option is used, all stations with the same tracker type are deleted. For example, if ALL3 is input all stations with the last character of "3" or "A" will be deleted since their tracker types (5) are identical.

3. TDRS ID = SIC - 1299, where SIC = Support Identification Code (The TDRS ID should be the actual number contained in the 60-byte observation data for the forward link or the return link.)

4. Up to three combinations may be specified in columns 18 through 38. A single combination is given as TTMR.0, two combinations as TTMRTTMR.0, and three combinations as TTMRTTMRTTMR.0. Each combination must be represented by four digits. If the type is a single digit, it must be preceded by a zero. If type, mode, or rate

editing is not to be performed, the appropriate position should be filled by a zero.

5. If the start time is equal to the end time, all other information on this card will be ignored. The editing will be treated as a single point edit, and all observations which occur at the single point edit time, regardless of tracker type, will be deleted.

DCFDR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	DCFDR--keyword to set the option to output osculating or Brouwer mean elements in the Orbital Elements Report (also known as Flight Dynamics Report) following completion of DC Program
9-11	I3	Output option indicator: = 0, osculating elements (default) = 1, Brouwer mean elements
12-80		Blank

DCOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EARLYORB, DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	DCOPT--keyword to specify processing of DCOPT subdeck
9-80		Blank

Use of the DCOPT subdeck identifier keyword permits processing of those optional keywords that pertain to a DC, EARLYORB, DATASIM, or ANALYSIS Program run.

The DCOPT deck can contain the following keyword cards:

Aɓɓɓ****	MAPTIMES	SSOPT
ACCREJ	MODDCSOR	SSTSIM
ATMOSEDT	OASENSOR	TRACKELV
CONSIDER	OBSCORR	TRNDLY
CONVERG	PARTRTMS	/*******1
CWEIGHT	PASSTIME	/*******2
Dɓɓɓ****	PRINTOUT	/*******3
DCFDR	RAMB****	/*******4
DSPEA1	RAMBOPT	/*******5
DSPEA2	SAVE	/*******6
DSPEA3	SSCOVAR	/*******7
EDIT	SSELEM1	/*******8
ELLMODEL	SSELEM2	/*******9
INTEROUT	SSEPOCH	

The DCOPT subdeck must terminate with an END keyword card.

DECLVAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	DECLVAR--keyword to set the a priori standard deviations of declination or pitch coefficients when used with landmark data (see Note 1)
9-11	I3	Number of standard deviation values to be read (1 to 5, inclusive)
12-17		Blank
18-38	G21.14	A priori standard deviation of first coefficient (degrees)
39-59	G21.14	A priori standard deviation of second coefficient (degrees per second)
60-80	G21.14	A priori standard deviation of third coefficient (degrees per second or in degrees--see Note 2)

NOTES: 1. The coefficients are for declination or pitch, depending on the third integer field of the ATTANG3 keyword card.

2. To input additional standard deviations, use a second DECLVAR keyword card with the standard deviations of the fourth and fifth coefficients in the first and second real fields (columns 18 through 38 and 39 through 59). The default values of all a priori standard deviations are infinity (∞).

DISTCB

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	DISTCB--keyword to set the distance from the current central body at which sectioning is to occur
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Distance (kilometers) from the central body for flight section I
39-59	G21.14	Distance (kilometers) from the central body for flight section J
60-80	G21.14	Distance (kilometers) from the central body for flight section K

A maximum of 10 flight sections is allowed.

DISTNCB

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	DISTNCB--keyword to set the distance from the next central body at which sectioning is to occur
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Distance (kilometers) from the next central body for flight section I
39-59	G21.14	Distance (kilometers) from the next central body for flight section J
60-80	G21.14	Distance (kilometers) from the next central body for flight section K

A maximum of 10 flight sections is allowed.

The next central body of section N is the central body of section N + 1.

DMOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB, DATASIM, ANALYSIS, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	DMOPT--keyword to specify processing of the DMOPT subdeck
9-80		Blank

The DMOPT subdeck can contain the following keyword cards:

Abbb****	SATGROUP	WORKELS	
ACCREJ	SELOUT	WORKGEO	
CHWT****	SLPBODY	WORKINT	
Dbbb****	SLPCOORD	WORKIONO	
LIFETIME	SLPDEG	WORKMAN	
MAXOBS	SLPFILE	WORKOBS	
MIXPAIR	SORINPUT	WORKSECT	
NOIS****	SORVALID	WORKTCOR	
OBSDEV	WORKATM	/*******1	See station
RELAYID	WORKCON	/*******2	keywords.

The DMOPT subdeck must terminate with an END keyword card. If additional subdecks are also used (DCOPT, OGOPT, etc.), they must follow the DMOPT subdeck (i.e., if DMOPT is used, it must be the first subdeck in each program input deck).

DRAG

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	DRAG--keyword to set the drag force model option for each section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	= 1.0, include drag option for section I = 2.0, do not include drag option for section I (default)
39-59	G21.14	= 1.0, include drag option for section J = 2.0, do not include drag option for section J (default)
60-80	G21.14	= 1.0, include drag option for section K = 2.0, do not include drag option for section K (default)

A spacecraft area and mass must be specified on the SCPARAM keyword card when using this option. See the ATMOSDEN keyword card for the type of atmospheric density model.

DRAGCOF

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	DRAGCOF--keyword to set polynomial coefficients of ρ_1 by flight section. The polynomial is of the form $$\rho_1 = a_1 + a_2t + \ldots + a_6t^5$$
9-11	I3	Flight section I (I = 1,10)
12-14	I3	Subscript (J) for the coefficient appearing in columns 18-38 (where J = 1 or 4)
15-17		Blank
18-38	G21.14	Polymonial coefficient corresponding to the Jth subscript for section I (default = 0.0)
39-59	G21.14	Polynomial coefficient corresponding to the (J+1)th subscript for section I (default = 0.0)
60-80	G21.14	Polynomial coefficient corresponding to the (J+2)th subscript for section I (default = 0.0)

NOTE: A DRAGPOLY keyword card is required whenever the DRAGCOF keyword card is used.

DRAGPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	DRAGPAR--keyword to update drag parameters and set the drag partial derivatives switch to compute ρ_1
9-11	I3	Drag options: = 0, turn off drag partial derivatives switch = 1, compute partial derivatives of state with respect to ρ_1 = 3, update default parameter (see DRAGCOF and DRAGPOLY)
12-14	I3	Drag parameter type (use a separate DRAGPAR keyword card to update each parameter): = 0, drag coefficient, C_{D_0} (default = 2) = 2, time variation in atmospheric density, ρ_2 (default = 0.0) = 3, diurnal variation in atmospheric density, ρ_3 (default = 0.0) = 4, angle between Sun line and the apex of the diurnal atmospheric bulge, ρ_4 (default = 30.0 degrees) = 5, power of cosine term, N (default = 6)
15-17	I3	Power of cosine term, N (if column 14 = 5)
18-38	G21.14	Value of drag parameter to be updated (if column 14 < 5)
39-59		Blank
60-80	G21.14	Standard deviation of drag variation

In a DC Program run, the compute partial derivatives option indicates that the drag parameter, ρ_1, will be solved for

or considered using either the default value or the value in columns 18 through 38 as the a priori estimate and the a priori standard deviation in columns 60 through 80. If the drag option (columns 9 through 11) is equal to 3, the drag parameter type indicated in columns 12 through 14 is to be updated by the user. If the drag parameter type is 0, 2, 3, or 4, the updated value of the drag parameter is input in columns 18 through 38. However, if the drag parameter type is 5, the updated value of the drag parameter is input in columns 15 through 17.

This keyword card must be used in the force model, to compute partial derivatives of the state with respect to ρ_1 (the drag parameter). If the user has not supplied the DRAG keyword card to invoke the drag option, and the DRAGPAR keyword card specifies that partial derivatives are to be computed, the drag option will be automatically invoked.

The product of the density at time t and the aerodynamic drag coefficient, C_D, is given by

$$C_D\rho(t) = C_{D_0} (1 + \rho_1) \quad 1 + \rho_2(t - t_0) \quad 1 + \rho_3 \cos^N \frac{\psi(\rho 4)}{2} \quad \rho_0$$

where ρ_0 is obtained by exponential interpolation within the stored density table, ψ is the angle between the satellite position vector and the apex of the diurnal bulge, which is computed using ρ_4 (the angle between the Sun line and the apex of the diurnal bulge), and C_{D_0} ρ_1, ρ_2, ρ_3, and N are defined in the format description above.

DRAGPOLY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	DRAGPOLY--keyword to establish the number of polynomial coefficients of ρ_1 to be applied and/or solved for by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Number of coefficients to be solved for in-flight section I (see columns 18 through 38) = 1.0, constant value for ρ_1 (default) = 2.0, linear form for ρ_1 = 3.0, quadratic form for ρ_1 = 4.0, 4th-order polynomial = 5.0, 5th-order polynomial = 6.0, 6th-order polynomial
39-59	G21.14	Number of coefficients to be solved for in-flight section J (see columns 18 through 38) = 1.0, constant value for ρ_1 (default) = 2.0, linear form for ρ_1 = 3.0, quadratic form for ρ_1 = 4.0, 4th-order polynomial = 5.0, 5th-order polynomial = 6.0, 6th-order polynomial
60-80	G21.14	Number of coefficients to be solved for in-flight section K (see columns 18 through 38) = 1.0, constant value for ρ_1 (default) = 2.0, linear form for ρ_1 = 3.0, quadratic form for ρ_1 = 4.0, 4th-order polynomial = 5.0, 5th-order polynomial = 6.0, 6th-order polynomial

NOTE: See keyword cards DRAGCOF and DRAGPAR.

DSPEA1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	DSPEA1--keyword to set simulated tracking schedule data
9-11	I3	Type of tracking schedule = 1, input a detailed tracking schedule and repeat periodically = 2, determine the tracking schedule as a function of satellite passes (default) = 3, determine the tracking schedule as a function of special events = 4, determine the tracking schedule as a function of a DODS observation tape
12-14	I3	Type of DATASIM output observation tape (JCL must be provided; see Section 5): = 0, GTDS observation tape (FORTRAN unit 29)(default) = 1, GTDS and DODS observation tape (FORTRAN units 29 and 30, respectively) = 2, DODS observation tape (FORTRAN unit 30) = 3, Generalized Data Handler (GDH) observation tape (FORTRAN unit 91; used only for SST simulation)
15-17	I3	Epoch revolution number (default = 0)
18-38	G21.14	Start time of DATASIM run or ANALYSIS run (yymmdd.) (see Note)

Columns	Format	Description
39-59	G21.14	Start time of DATASIM run or ANALYSIS run (hhmmss.ssss)
60-80	G21.14	Rate at which to determine satellite passes in seconds (default = 60 seconds--used as frequency of observations if no frequency is specified on station card 7)

NOTE: If blank, the default is the start time of the input ephemeris file. When USB stations are used, the run start time should be later than the file start time by more than one observation interval (given by the third real field of this keyword card) due to handling of uplink and downlink times.

DSPEA2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	DSPEA2--keyword to specify input ORBIT File and end simulation timespan
9-11	I3	FRN of input ephemeris file to be used for a DATASIM or ANALYSIS program run (default = 22) (see Note). For SST simulation, the FRN of target satellite ORBIT File is used.
12-14	I3	Level of direct access ORBIT File (zero implies a sequential file)
15-17	I3	Random noise indicator (default = 0; applicable to DATASIM only): = 0, no noise in the run = 1, compute noise in the run
18-38	G21.14	End time of DATASIM program run or ANALYSIS run (yymmdd.) (The default is the end time of the input ephemeris file.)
39-59	G21.14	End time of DATASIM program or ANALYSIS run (hhmmss.ssss)
60-80	G21.14	Type of range-rate modeling: = 1, VHF range-rate (default) = 2, VHF range difference

NOTE: FORTRAN reference numbers used are as follows:

Primary Unit	Secondary Unit	Description
19	86	ORBIT File with partial derivatives (direct access)
20	88	ORBIT File without partial derivatives (direct access)

Primary Unit	Secondary Unit	Description
21	82	ORBIT File with partial derivatives (sequential)
22	84	ORBIT File without partial derivatives (sequential)

When simulating satellite-to-satellite data, use the secondary unit for the target satellite. Proper JCL must be provided (see Section 5).

DSPEA3

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	DSPEA3--keyword to specify various DATASIM Program output options
9-11	I3	Station Pass (Contact) Report option = 0, do not output Station Pass (Contact) Report but output Summary Report = 1, output Station Pass (Contact) Report and Summary Report but no DATASIM Program observation tapes = 2, output Station Contact Report and Summary Report and DATASIM Program observation tapes
12-14	I3	DATASIM observations printer frequency: = n, print every nth DATASIM observation to printer = 1, default = 0, no printout
15-17	I3	DATASIM summary file option: = 0, output the DATASIM Summary File = 1, do not output the DATASIM Summary File
18-80		Blank

For best results the Station Pass (Contact) Report should be used with a Type 1 schedule with one period and one interval or with a Type 2 schedule. (For Type 1 and Type 2 schedule definitions, see the DSPEA1 card.)

For the Station Pass (Contact) Report only, a DD card in the JCL for the observation tapes is not required. The program will default to a Type 1 schedule with one interval, and will observe the satellite every TPASS seconds, where TPASS is the value in the third real field of the DSPEA1 card.

EDIT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	EDIT--keyword to set observation edit parameters
9-11	I3	Option to turn off inner loop editing = 1 (off), = 0, or blank (on, default)
12-14	I3	Option to exclude/include edited observations from residual report: = 1, exclude user-edited observations = 2, include edited observations (default)
15-17	I3	The maximum number of inner loops allowed (default = 15)
18-38	G21.14	RMS sigma multiplier (default = 3.0D0)
39-59	G21.14	Initial value of RMS (see Note 1) (default = 1.0D03) (see Note 2)
60-80	G21.14	RMS additive factor (see Note 1) (default = 0.0D0)

If the ACCREJ keyword is present during a DC Program observations will be edited according to the specifications on the ACCREJ, Abbb****, and Dbbb**** keyword cards. The option to include edited observations allows the user to obtain the computation of the residual (O-C) for those observations edited by the detailed edit criterion.

NOTES:

1. Each observation residual at the ith iteration is compared with the quantity $N(RMS_{i-1}) + RMS_{ADD}$, where N is the RMS sigma multiplier. RMS_{i-1} is the RMS value of the (i-1)st iteration (initialized by the value in columns 39 through 59) and RMS_{ADD} is specified in columns 60 through 80. A weighted residual greater than this value will result in the observation being edited for the given iteration.
2. If elements are retrieved from an Elements File, the initial value of RMS will be that contained on the file unless overridden with a value in this field.

ELEMENT1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	ELEMENT1--keyword to set the first three components of the initial state vector and to identify the coordinate system and reference central body of the initial state
9-11	I3	Input coordinate system orientation: = 1, mean Earth equator and equinox of 1950.0 = 2, true of reference, Earth equator and equinox (see Note) = 3, true of date, Earth equator and equinox = 4, mean ecliptic and equinox of 1950.0 (Cowell integrators only) = 5, true of epoch, ecliptic, and equinox (Cowell integrators only) = 6, mean Earth equator and equinox of J2000.0
12-14	I3	Input coordinate system type: = 1, Cartesian = 2, Keplerian = 3, spherical = 4, Brouwer mean = 5, DODS flight parameters = 6, averaged Keplerian (for averaged VOP integrators only) = 7, Keplerian selenographic (body-fixed Moon-centered)
15-17	I3	Input reference central body index of the initial state (see Note): = 1, Earth = 2, Moon = 3, Sun

Columns	Format	Description
15-17 (Cont'd)		= 4, Mars
		= 5, Jupiter
		= 6, Saturn
		= 7, Uranus

NOTE: The reference date can be set via the TIMES keyword card. The default reference data is the epoch year, month, and day.

ELEMENT1
(mandatory)

Columns	Format	Description
15-17 (Cont'd)		= 8, Neptune = 9, Pluto = 10, Mercury = 11, Venus

The next three fields contain the elements (in units of kilometers, seconds, and degrees) corresponding to the coordinate system type specified in the second integer field (columns 12 through 14) of this card:

Columns	Format	Description: Cartesian	Spherical	DODS	Other Coordinate System Types
18-38	G21.14	X position	Right ascension (α)	East longitude	Semimajor axis (a)
39-59	G21.14	Y position	Declination (δ)	Geodetic latitude	Eccentricity (e)
60-80	G21.14	Z position	Vertical flight path angle	Horizontal flight path angle	Inclination (i)

This keyword has no default values.

NOTE: When Keplerian selenographic coordinates are used, the reference central body must be the Moon.

ELEMENT2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	ELEMENT2--keyword to set the second three components of the initial state (degrees)
9-17		Blank

The next three fields contain the elements (in units of kilometers, kilometers/second, and degrees) corresponding to the coordinate system type specified in the second integer field (columns 12 through 14) of the ELEMENT1 keyword card:

Columns	Format	Description: Cartesian	Spherical	DODS	Other Coordinate System Types
18-38	G21.14	X velocity	Azimuth (inertial)	Azimuth inertial	Longitude of ascending node (Ω)
39-59	G21.14	Y velocity	Radius (r)	Radius (r)	Argument of perigee (ω)
60-80	G21.14	Z velocity	Velocity (v)	Velocity (v)	Mean anomaly (M)

This keyword has no default values.

ELLMODEL

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	ELLMODEL--keyword to define ellipsoid model (maximum of five models allowed) for conversion of tracking station coordinates
9-11	I3	Model number ($1 \leq$ model ≤ 5)
12-17		Blank
18-38	G21.14	Semimajor axis of ellipsoid
39-59	G21.14	Inverse flattening coefficient of ellipsoid
60-80		Blank

The Tracking Station Geodetics File uses model 1, which defaults to the following values:

- Semimajor axis of ellipsoid = 6378.166
- Inverse flattening coefficient of ellipsoid = 298.3

These default values for model 1 can be changed through the use of this card. New station coordinates supplied through data cards (Station Card 1 and Station Card 2) can refer to ellipsoid models other than model 1. Additional models must be defined through this card.

ELSRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	ELSRPT--keyword to specify a report of the GTDS Permanent Elements File
9-11	I3	General report indicator: = 0, no report = 1, directory report = 2, report of last set saved for each satellite on the file
12-14	I3	Full element set report indicator: = 0, no report will be printed = 1, all sets for a particular satellite = 2, all sets for all satellites = 3, a particular element set
15-17	I3	Summary element set report indicator: = 0, no report will be printed = 1, all sets for a particular satellite = 2, all sets for all satellites
18-38	G21.14	Satellite ID (needed if column 11 = 1 or 3, or column 17 = 1)
39-59	G21.14	Element set number (if column 14 = 3)
60-80		Blank

This keyword card may be included only once per PFROPT sub-deck.

ELS24RPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	ELS24RPT--keyword to specify a report of the GTDS 24-Hour Hold Elements File
9-11	I3	Summary report indicator (see Note): = 0, no summary report will be printed = 1, summary report will be printed
12-14	I3	Full report indicator (see Note): = 0, no full report will be printed = 1, full report will be printed
15-17		Blank
18-38	G21.14	Report particular element set (see Note): = 0, no report of particular set > 0, element set number to be reported
39-59	G21.14	Start time of element report (needed if column 11 or column 14 0): = yymmddhhmmss.ssss
60-80	G21.14	End time of element report (needed if column 11 or column 14 0): = yymmddhhmmss.ssss

This card may be included only once per PFROPT subdeck.

NOTE: Indicators for Summary Report, Full Report, and Particular Element Set Report are mutually exclusive.

END

- Card format (A3)
- Applicable programs: EPHEM, DC, EARLYORB, DATASIM, ANALYSIS, COMPARE, DATAMGT, FILERPT
- Detailed format:

Columns	Format	Description
1-3	A3	END--keyword that identifies the end of a subdeck
4-80		Blank

The END card must be the last card of every subdeck included in the input deck.

EODOUBLR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EARLYORB, DC
- Detailed format:

Columns	Format	Description
1-8	A8	EODOUBLR--keyword to specify parameters for the Double-R method of early orbit extraction.
9-11	I3	=1, the user is specifying the number of orbital revolutions between observations =0, software will determine the number of revolutions (default)
12-14	I3	Number of revolutions between observations 1 and 2 (default = 0)
15-17	I3	Number of revolutions between observations 2 and 3 (default = 0)
18-38	G21.14	Minimum accuracy in seconds to terminate Double-R (default = 0.2 second)
39-59	G21.14	Maximum correction used in diffential correction (default = 10^{10}km)
60-80	G21.14	Spare

EOOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	EOOPT--keyword to specify processing of the EOOPT subdeck.
9-80	Blank	

EOINTRVL

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EARLYORB, DC
- Detailed format:

Columns	Format	Description
1-8	A8	EOINTRVL--keyword to set the minimum time difference between observations
9-17		Blank
18-38	G21.14	Minimum interval between observations to be selected by an automatic early orbit determination method in seconds (default = 30 seconds)
39-59		Minimum elevation angle beneath which early orbit processing will not select observations (default = 0.0 degrees)
60-80		Blank

EPHMERGE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	EPHMERGE--keyword to specify EPHEM File merge start time, end time, and tolerance (see Note 1)
9-17		Blank
18-38	G21.14	Year, month, day, hours, minutes, seconds of start time of merge (yymmddhhmmss.ssss) (see Note 2)
39-59	G21.14	Year, month, day, hours, minutes, seconds of end time of merge (yymmddhhmmss.ssss) (see Note 3)
60-80	G21.14	Merging tolerance (kilometers) (see Note 4)

NOTES:

1. The files to be merged must be input on FRN 24 and 81. The output must be on FRN 83.
2. If blank or zero, the default is the start time of the first EPHEM File.
3. If blank or zero, the default is the end time of the second EPHEM File.
4. The merging tolerance must be set by the user. There is no default value.

EPHQLCRT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	EPHQLCRT--keyword to request printout of selected data points from EPHEM or ORB1 Files
9-11	I3	First ephemeris point to be printed
12-14	I3	Second ephemeris point to be printed
15-17	I3	Third ephemeris point to be printed
18-38	G21.14	Fourth ephemeris point to be printed
39-59	G21.14	Fifth ephemeris point to be printed
60-80	G21.14	Sixth ephemeris point to be printed

As many as six points (position and velocity vectors) may be printed from each block of 50 in the ephemeris record. Each point is specified by a number from 1 to 50, inclusive, in one of the six numerical fields of this keyword card.

EPOCH

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	EPOCH--keyword to set satellite epoch
9-17		Blank
18-38	G21.14	Year, month, day of epoch (yymmdd.) (see Note)
39-59	G21.14	Hours, minutes, seconds of epoch (hhmmss.ssss)
60-80	G21.14	Automatic epoch advance option (for DC Program only)--year, month, day, hours, minutes, seconds of epoch about which to perform DC (yymmddhhmmss.ssss). The default is no epoch advance desired.

NOTE: This date will be the default for the reference date when integrating in the true of reference system unless overridden by the keyword TIMES.

EPOTRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	EPOTRPT--keyword to specify a report of the Earth Potential Fields File
9-11	I3	Type of report indicator: = 0, summary = 1, partial = 2, full
12-14	I3	Number of models: = 0, all models ≠ 0, model number (see Appendix D, Item A)
15-80		Blank

This card must be included only once per PFROPT subdeck.

FIN

- Card format: (A3)
- Applicable programs: EPHEM, DC, EARLYORB, DATASIM, ANALYSIS, COMPARE, DATAMGT, FILERPT
- Detailed format:

Columns	Format	Description
1-3	A3	FIN--keyword that indicates the end of a program input deck
4-80		Blank

The FIN card must be the last card in every program input deck.

FLATCOEF

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	FLATCOEF--keyword to set the inverse of the flattening coefficients
9-11	I3	Index of body I
12-14	I3	Index of body J
15-17	I3	Index of body K
18-38	G21.14	Inverse of flattening for body I
39-59	G21.14	Inverse of flattening for body J
60-80	G21.14	Inverse of flattening for body K

The body indexes are as follows:

1 = Earth	5 = Jupiter	9 = Pluto
2 = Moon	6 = Saturn	10 = Mercury
3 = Sun	7 = Uranus	11 = Venus
4 = Mars	8 = Neptune	

GEODRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	GEODRP--keyword to specify a report of the Tracking Station Geodetics File
9-80		Blank

This card may be included only once per PFROPT subdeck.

GMCON

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	GMCON--keyword to set gravitational constants for specified bodies
9-11	I3	Index for body I
12-14	I3	Index for body J
15-17	I3	Index for body K
18-38	G21.14	Gravitational constant (kilometer^3 per second^2) for body I
39-59	G21.14	Gravitational constant (kilometer^3 per second^2) for body J
60-80	G21.14	Gravitational constant (kilometer^3 per second^2) for body K

The body index are as follows:

1 = Earth	5 = Jupiter	9 = Pluto
2 = Moon	6 = Saturn	10 = Mercury
3 = Sun	7 = Uranus	11 = Venus
4 = Mars	8 = Neptune	

HARMONIC

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	HARMONIC--keyword to read an entire harmonics field table
9-11	I3	Data type sentinel: = 1, harmonics are $C_{n,m}$ = 2, harmonics are $S_{n,m}$ = 3, indicates end of harmonics table
12-14	I3	N, degree of the field (maximum = 21)
15-17	I3	Index of body: = 1, Earth = 2, Moon
18-38	G21.14	Value of the ith harmonic for specified body
39-59	G21.14	Value of the (i + 1)th harmonic for specified body
60-80	G21.14	Value of the (i + 2)th harmonic for specified body

Multiple keyword cards are normally used to change an entire harmonics field. The keyword must only appear on the first card. All cards following the first card will be treated as harmonics cards until the end of harmonics table is read. A "3" in the first integer field of a card indicates the end of the table.

The harmonics must be given in the following order:

$$C_{2,0}, C_{3,0}, \ldots, C_{n,0}, C_{2,1}, C_{3,1}, \ldots,$$
$$C_{n,1}, C_{n,m}$$

where n = 2, 3, ...,N, m = 0, 1, ..., M and $n \geq m$. The same is true for the $S_{n,m}$ values.

Harmonics for multiple bodies can be changed by repeating the keyword HARMONIC with the proper body specified in columns 15 through 17 of the first data card of this set. See Figure 4-3 for a sample of a 4 x 4 field, in the GTDS format. Keyword cards CNM and SNM may be used to change individual values in the harmonics table (see Reference 2, Section 4.3, for $C_{n,m}$ and $S_{n,m}$ definitions).

Harmonics Table (GTDS Format)

COLUMN

1	8	11	14	17	18 38	39 59	60 80
HARMONIC		1	4	1	-0.10826271D-02	0.25358868D-05	0.16246180D-05
					-0.27635957D-09	0.21907694D-05	-0.50552749D-06
					0.15711423D-05	0.30466825D-06	0.78842515D-07
					0.97966803D-07	0.59073749D-07	-0.41542493D-08
HARMONIC		3					
HARMONIC		2	4	1	-0.52357454D-08	0.27267074D-06	-0.50552749D-06
					-0.90231337D-06	-0.21259298D-06	0.14818958D-06
					0.19681077D-06	-0.12140873D-07	0.63163541D-08
HARMONIC		3					

HISTPLOT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	HISTPLOT--keyword to set the element history plot options
9-11	I3	Plot option (no default) (see Note 1): = 1, all 14 plots = 2, six Keplerian elements plots = 3, six Keplerian elements and two radius plots = 4, six equinoctial elements plots
12-14	I3	The primary file (see Note 2) = (file type) *100 + (file level) *10 + (partial derivative switch)
(12)		File type (no default): = -1, two ORBIT File levels with the same FRN = 0, ORBIT File = 1, ORB1 File = 2, EPHEM File
(13)		File level (no default): = 0, sequential file ≠ 0, direct access file
(14)		Partial derivative switch: = 1, with partial derivatives = 2, without partial derivatives
15-17	I3	The secondary file (specified in the same manner as the primary file; see Note 2)
18-38	G21.14	Start time of plot (yymmddhhmmss.sss; no default)
39-59	G21.14	End time of plot (yymmddhhmmss.sss; no default)
60-80	G21.14	Time interval between two consecutive points in a plot in seconds (default = 60 seconds)

NOTES:

1. See OUTPUT keyword card description for mandatory input when plots are desired.

2. As an optional card in OGOPT, columns 12 through 17 are not used.

HSTSCALE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, COMPARE
- Detailed format:

Columns	Format	Description
1-8	A8	HSTSCALE--keyword to set the scales for element history plots (see the description of the HISTPLOT keyword card)
9-11	I3	Type plot: For Keplerian elements: = 1, semimajor axis = 2, eccentricity = 3, inclination = 4, longitude of ascending node = 5, argument of perifocus = 6, mean anomaly For radius: = 7, radius of perifocus = 8, radius of apofocus For equinoctial elements: = 9, semimajor axis = 10, h = 11, k = 12, p = 13, q = 14,
12-14	I3	≠ 0 on any HSTSCALE card will suppress the plots not specified on a HSTSCALE card (see Note)
15-17		Blank
18-38	G21.14	Minimum Y scale
39-59	G21.14	Maximum Y scale
60-80		Blank

NOTE: One or more HSTSCALE cards may be used in the OGOPT or COMPOPT subdecks. A nonzero integer in columns 12 through 14 of one of HSTSCALE cards will give only the plots which are specified by HSTSCALE cards. The HISTPLOT keyword card is necessary for element history plots; the HSTSCALE card is optional.

IMPACT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	IMPACT--keyword to enable impact processing function in GTDS Release 3. When the IMPACT card is submitted, only the Cowell, Time-Regularized Cowell and Hull Runge-Kutta 3(4+) orbit generators may be specified in the OGOPT subdeck.
9-11	I3	Blank
12-14	I3	Blank
15-17	I3	Low-atmosphere density model switch: = 0, Low-atmoshphere density model disabled; drag force calculated with density set to zero (default) = 1, Low-atmosphere density model enabled
18-38	G21.14	Transition height: Altitude (in km) at and below which integration will be performed by the Hull Runge-Kutta 3(4+) integrator
39-59	G21.14	Impact height: Altitude (in km) at which trajectory propagation will stop and an impact report be generated
60-80	G21.14	Not used

IMPACT
(OGOPT)

NOTE:

When using the impact processor, an appropriate integration stepsize must be selected on the ORBTYPE keyword card. In particular, the user should keep in mind the following:

1. The integration stepsize should be no larger than the output stepsize.
2. For a "normal" impact processing run (transition height from 70 to 400 km, velocity at transition height from 7 to 9 km/s), stepsizes of 5 to 10 seconds are a good choice.
3. If the trajectory is propagated below impact height or even below the Earth's surface, the user should try reducing the integration stepsize. This may be necessary if the transition height is low.

Reducing the integration time step for the time-regularized Cowell orbit generator means increasing the number of steps per orbit period.

IMPULSE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	IMPULSE--keyword to set the impulsive maneuver velocity increments
9-11	I3	Maneuver number (1, 2, ..., 5)
12-14	I3	Coordinate system reference for the maneuver: = 1, mean equator and equinox of 1950.0 = 2, true of reference
15-17	I3	Type maneuver: = 1, normal impulsive maneuver: X, Y, Z = 2, maneuver uses V in R1 field, yaw and pitch angles of V with respect to orbital plane in R2 and R3 fields (angles given in degrees) = 3, Earth Resources Technology Satellite (ERTS) type maneuver = 4, constants C1, C2, and C3 in the ERTS gating maneuver model are contained in the three real fields (see Note) = 5, constants C4 and C5 in the ERTS gating maneuver model are contained in the first two real fields (see Note)
18-38	G21.14	X velocity increment (kilometers per second) or magnitude of the velocity increment, V (kilometers per second)
39-59	G21.14	Y velocity increment (kilometers per second) or yaw angle of V
60-80	G21.14	Z velocity increment (kilometers per second) or pitch angle of V

One card must be supplied for each maneuver. Associated MANTIME and MANMASS keyword cards must also be used.

NOTE: Two IMPULSE cards are needed to change default values of all five constants (C1 through C5) in the ERTS gating maneuver model.

INTCRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	INTCRPT--keyword to specify a report of the Integration Coefficients File
9-11	I3	General file description report indicator: = 0, no report will be printed = 1, a report will be printed
12-14	I3	Specific integration coefficient set report: = 0, no > 0, degree of integration coefficient set (minimum = 4, maximum = 19)
15-80		Blank

This card may be included only once per PFROPT subdeck.

INTEG

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	INTEG--keyword to set the numerical integration parameters
9-11	I3	Numerical integration type: = 1, single point off-grid = 2, second sum Cowell (default) = 3, Adams = 4, Runge-Kutta (see Note)
12-14	I3	Cowell integration order for equations of motion (default = 12)
15-17	I3	Cowell integration order for variational equations (default = 8)
18-80		Blank

NOTE: The Cowell orbit generator must be requested via the ORBTYPE keyword card in order to use the Runge-Kutta integrator.

INTEROUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATASIM, ANALYSIS
- Detailed format:

For DCOPT and OGOPT subdecks:

Columns	Format	Description
1-8	A8	INTEROUT--keyword to request intermediate output from selected subroutines
9-11	I3	Subroutine number I from which output is desired
12-14	I3	Subroutine number J from which output is desired
15-17	I3	Subroutine number K from which output is desired
18-38	G21.14	Frequency (n) of desired output from subroutine I (n = number of entries into the subroutine)
39-59	G21.14	Frequency of desired output from subroutine J (n = number of entries into the subroutine)
60-80	G21.14	Frequency of desired output from subroutine K (n = number of entries into the subroutine)

The subroutine numbers are as follows for the three real fields:

OGOPT Subdeck (See Note)

1 = VARFRC	18 = None
2 = None	19 = ATMOS
3 = RESINC	20 = HEIGHT
4 = ORBITC	21 = FORCV
5 = NEWTAB	22 = None
6 = TESTH	23 = SUMS
7 = CSTEP	24 = RESUME
8 = PMASSV	25 = PARTE
9 = SLRADV	26 = None
10 = None	27 = MSTART
11 = HARMV	28 = SECUPD
12 = PMASS	29 = SECHKN
13 = EVAL	30 = CROSSC
14 = CSHAD	31 = INTOGN
15 = SOLRAD	32 = RESWRM
16 = HARMON	33 = ANPART
17 = SPART	

DCOPT Subdeck (See Note)

1 = None	8 = None
2 = ITERCT	9 = RESTAT
3 = NOREST	10 = INTDC (See Note 1)
4 = OBS	11 = TRANF
5 = OBSCOR	12 = READWF
6 = OBSP	13 = CORDBA
7 = None	

NOTE: For subroutine INTDC, the output frequency is each DC Program iteration; otherwise frequency is by every mth observation for every nth iteration ($1 \leq m \leq 999$, $0 \leq n$) given in the form nnmmm (e.g., 10020 means output data every 20th observation every 10th iteration).

INTMODE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

For DCOPT and OGOPT subdecks:

Columns	Format	Description
1-8	A8	INTMODE--keyword to set integration stepsize control mode
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Integration step mode setting for section I
39-59	G21.14	Integration setp mode setting for section J
60-80	G21.14	Integration step mode setting for section K

Step mode settings:

1.0 = fixed step (default)

2.0 = regular vary step

3.0 = shells

4.0 = halving-doubling

A maximum of 10 sections is allowed.

LIFETIME

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	LIFETIME--keyword to set the orbit generator in the lifetime study mode
9-11	I3	Source of input elements: = 1, from the GTDS Permanent Elements File (unit 25) = 2, from cards
12-14	I3	First elements set number requested if input is from the Permanent Elements File
15-17	I3	Last elements set number requested if input is from the Permanent Elements File
18-38	G21.14	The minimum acceptable perifocal radius (default = 0.0 kilometer)
39-59	G21.14	The maximum acceptable apofocal radius (default = 10^{14} kilometers)
60-80		Blank

When the GTDS Permanent Elements file is used as the source of initial elements, a sequence of cases will be run, starting with the first elements set number specified and continuing until the last elements set number specified has been used.

LNDPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	LNDPAR--keyword to set data for processing landmark (spinning) observables
9-11		Blank
18-38	G21.14	Sun sensor-to-visor angle (degrees)
39-59	G21.14	Satellite spin rate (degrees per second)
60-80		Blank

LOWBOUND

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	LOWBOUND--keyword for setting the step size control lower truncation error boundary
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Lower bound for section I (greater than zero)
39-59	G21.14	Lower bound for section J (greater than zero)
60-80	G21.14	Lower bound for section K (greater than zero)

A maximum of 10 sections are allowed. The lower error bound initial value for all sections can be set to the same value by using the keyword TOLER at the user's option.

LPOTRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	LPOTRPT--keyword to specify report of the Lunar Potential Fields File
9-11	I3	Type of report indicator: = 0, summary report = 1, partial report = 2, full
12-14	I3	Number of models to be reported: = 0, all models 0, number of model to be reported (see Appendix D, Point B)
15-80		Blank

This card may be included only once per PFROPT subdeck.

MANMASS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MANMASS--keyword to set the satellite mass required to compute impulsive maneuvers
9-11	I3	Maneuver number (see IMPULSE keyword description)
12-17		Blank
18-38	G21.14	Satellite mass before maneuver (kilograms) (must be greater than zero)
39-59	G21.14	Satellite mass after maneuver (kilograms) (must be greater than zero)
60-80		Blank

One card must be supplied for each maneuver. Associated IMPULSE and MANTIME keyword cards must also be used.

MANMASS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MANTIME--keyword to set the time of the impulsive maneuver
9-11	I3	Maneuver number (see IMPULSE keyword description)
12-14		Blank
15-17	I3	Revolution counter for maneuver (specifies maneuver at certain vertical crossing instead of time)
18-38	G21.14	Year, month, day of maneuver (yymmdd.0)
39-59	G21.14	Hours, minutes, seconds of maneuver (hhmmss.ssss)
60-80		Blank

One card must be supplied for each maneuver. Associated IMPULSE and MANMASS keyword cards must also be used.

MANURPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	MANURPT--keyword to specify a report of the Impulsive Maneuvers File
9-11	I3	Directory report indicator: = 0, do not print directory report = 1, print maneuver data
12-14	I3	Data report indicator = 0, do not print = 1, print report
15-17		Blank
18-38	G21.14	Satellite ID (required if column 14 = 1)
39-59	G21.14	Start time (required if column 14 = 1) = yymmddhhmmss.ssss
60-80	G21.14	End time (required if column 14 = 1) = yymmddhhmmss.ssss

This card may be included only once per PFROPT subdeck.

MAPTIMES

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	MAPTIMES--keyword to map the epoch covariance matrix to other times
9-11	I3	Standard deviation breakdown is to be carried out: = 1, yes = 2, no (default)
12-14	I3	Coordinate system in which sensitivity breakdown is to be performed: = 1, Cartesian (default) = 2, Keplerian = 3, orbit plane
15-17	I3	Mapped covariance matrix is at the last mapping time to be printed: = 1, yes = 2, no (default)
18-38	G21.14	Mapping start time (yymmddhhmmss.ssss)
39-59	G21.14	Mapping end time (yymmddhhmmss.ssss)
60-80	G21.14	Mapping time interval (seconds)

The real fields must be specified. There are no default values for start time, end time, or mapping time interval.

MASS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MASS--keyword to set the spacecraft mass (kg) by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Spacecraft mass (kg) for section I
39-59	G21.14	Spacecraft mass (kg) for section J
60-80	G21.14	Spacecraft mass (kg) for section K

The spacecraft mass for section one is normally set by using the SCPARAM keyword card. Specifying section one on this card will cause this initial mass to be overridden. A maximum of 10 flight sections is allowed.

MASSRATE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MASSRATE--keyword to set the spacecraft mass rate by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Spacecraft mass (kg/sec) for section I
39-59	G21.14	Spacecraft mass (kg/sec) for section J
60-80	G21.14	Spacecraft mass (kg/sec) for section K

A maximum of 10 flight sections is allowed.

MAXDEGEQ

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MAXDEGEQ--keyword to set the maximum degree to be used in evaluating the nonspherical potential of the central body when evaluating the equations of motion of the satellite
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Maximum degree of potential for equations of motion for section I ($0 \leq N \leq 21$, default = 4)
39-59	G21.14	Maximum degree of potential for equations of motion for section J ($0 \leq N \leq 21$, default = 4)
60-80	G21.14	Maximum degree of potential for equations of motion for section K ($0 \leq N \leq 21$, default = 4)

A maximum of 10 flight sections is allowed.

MAXDEGVE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MAXDEGVE--keyword to set the maximum degree of the nonspherical potential to be used for the variational equations (The degree must be less than or equal to the degree of the equations of motion on the MAXDEGEQ keyword card.)
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Maximum degree for section I ($0 \leq N \leq 21$, default = 2)
39-59	G21.14	Maximum degree for section J ($0 \leq N \leq 21$, default = 2)
60-80	G21.14	Maximum degree for section K ($0 \leq N \leq 21$, default = 2)

A maximum of 10 flight sections is allowed.

MAXOBS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	MAXOBS--keyword to set the maximum number of observations to be accepted from the 60-byte observation tape or data base
9-17		Blank
18-38	G21.14	Maximum number of observations to be processed (default = 8000, maximum = 8000)
39-80		Blank

MAXORDEQ

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MAXORDEQ--keyword to set the maximum order of the nonspherical potential to be used for the equations of motion
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Maximum order for section I ($0 \leq N \leq 21$, default = 4)
39-59	G21.14	Maximum order for section J ($0 \leq N \leq 21$, default = 4)
60-80	G21.14	Maximum order for section K ($0 \leq N \leq 21$, default = 4)

A maximum of 10 flight sections is allowed.

MAXORDVE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MAXORDVE--keyword to set the maximum order of the nonspherical potential to be used for the variational equations (The order must be less than or equal to the order of the equations of motion on the MAXORDEQ keyword card.)
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Maximum order for section I ($0 \leq N \leq 21$, default = 0)
39-59	G21.14	Maximum order for section J ($0 \leq N \leq 21$, default = 0)
60-80	G21.14	Maximum order for section K ($0 \leq N \leq 21$, default = 0)

A maximum of 10 flight sections is allowed.

MAXSECT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MAXSECT--keyword to set the number of flight sections
9-11	I3	Number of sections (default = 1)
12-80		Blank

A maximum of 10 flight sections is allowed.

MEANEL

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	MEANEL--keyword to set the numerical osculating-to-mean element conversion options
9-11	I3	Orbit generator type: = 1, time-regularized Cowell (default) = 2, Cowell
12-14	I3	Number of orbital revolutions averaged over (default = 1)
15-17		Blank
18-38	G21.14	Step size used in ORBIT File generation (default = 150 steps per revolution for time-regularized Cowell and the period in seconds divided by 150 for Cowell)
39-80		Blank

The total number of steps used in the temporary ORBIT File for averaging must not be greater than 1880 because of the size of the file specified in the GTDS JCL procedure.

For the time-regularized Cowell orbit generator, the total number of steps is computed by multiplying the number of orbital revolutions averaged over (columns 12 through 14) by the number of steps per revolution (columns 18 through 38). If the number of steps per revolution in columns 18 through 38 is left blank, the number of orbital revolutions averaged over should be no greater than 12.

For the Cowell orbit generator, the period of the satellite should be divided by the step size in seconds (columns 18

through 38) to obtain the approximate number of steps per revolution.

That value should then be multiplied by the number of orbital revolutions averaged over (columns 12 through 14) to ensure that the total number of steps is not greater than 1880. If the step size is left blank, the number of orbital revolutions averaged over should be no greater than 12.

MIXPAIR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	MIXPAIR--keyword to mix a pair of Statistical Output Report Categories as a single SOR category
9-11	I3	Observation type number (see Appendix A, Table A-2) with the following exceptions: = 11, XY parabolic X85 = 12, XY parabolic Y85 = 17, SRE X14 = 18, SRE Y14 = 42, ATSR sidetone range
12-14	I3	Tracker type number (see Table 4-1) with the following exceptions: = 4, SRE X14, Y14 = 5, SRE X30, Y30 and UBS 85 range and range rate = 6, SRE X85, Y85
15-17	I3	Equipment mode indicator (applies only to Minitrack data and ATSR relay data): = 0, Minitrack equatorial mode = 1, Minitrack polar mode = 2, satellite PLL mode = 3, Satellite crystal mode = 4, ground crystal mode = 5, ground PLL mode Frequency band indicator (applies to TDRSS one-way or two-way Doppler data from user spacecraft but not to user ground transponders): = 1, S-Band = 2, K-Band Multiple access indicator (applies to TDRSS beam angle): = 1, single access (or undefined) = 2, multiple access

Columns	Format	Description
18-38	G21.14	Data rate indicator (applies only to ATSR range rate data in sidetone, coherent and ground relay mode): = 4, data rate is 6 per minute = 0, all others For other ATSR data types: = 0, for all data rates For TDRSS Doppler data (two-way, hybrid, or differenced one-way Doppler from ground transponser but not user spacecraft): = 1, data rate greater than 40 observations per minute (Δt less than 1.5 seconds per observation) = 2, data rate less than or equal to 40 observations per minute but greater than 9.23 observations per minute (Δt greater than or equal to 1.5 seconds but less than 6.5 seconds per observation) = 3, data rate less than or equal to 9.23 observations per minute (Δt greater than or equal to 6.5 seconds per observation) For other TDRSS data types: = 0, for all data rates
39-59		Blank
60-80	G21.14	Input a two digit number IJ.0 where I = number in pair (1 of 2) J = pair number (1, 2, or 3)

A maximum of three pairs of SOR categories can be mixed. SOR categories based on receive station acronym or TDRSS ground transponder index number (see CHWT keyword card) cannot be mixed.

MODDC

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	MODDC--keyword to indicate that the Marquardt algorithm (see Section 3.2.1.7) will be used
9-11	I3	Constant value between 2 and 10, inclusive, that multiplies the value of when divergence occurs in the differential correction procedure
12-17		Blank
18-38	G21.14	Initial value of λ in the enhanced differential correction mode. The suggested range is 0.0 to 1.0 (default = 0.0).
39-59	G21.14	Critical value of RMS relative change. The value of λ is halved when the change in RMS falls below the critical value. The suggested range is from 0.001 to 1.0 (default = 0.0).
60-80	G21.14	Cutoff value of λ. When λ becomes less than its cutoff value, it is set equal to zero. Suggested range is from 0.1λ to 0.00001λ (default = 0.0).

NCBODY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	NCBODY--keyword to set noncentral bodies for each section
9-11	I3	Flight section number
12-14	I3	Noncentral body indicator (integer)
15-17	I3	Noncentral body indicator (integer)
18-38	G21.14	Noncentral body indicator (real)
39-59	G21.14	Noncentral body indicator (real)
60-80	G21.14	Noncentral body indicator (real)

A second NCBODY card in the same format may be used to specify a total of eight noncentral bodies per section.

The default force model includes the effects of the Moon and Sun. To turn off these effects, the user would specify a zero in the second and third integer fields.

Body indicators are specified in Appendix B.

NOIMIN

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs:
- Detailed format:

Columns	Format	Description
1-8	A8	NOIMIN--keyword to set minimum valid points to perform noise analysis
9-17		Blank
18-38	G21.14	Minimum number of points (default = 0.D0)
39-80		Blank

NOIS****

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	NOIS****--keyword to set SOR noise determination criteria, where the asterisks optionally designate a tracker acronym or tracking system
9-11	I3	Noise evaluation technique: = 0, VDNA (variate difference noise analysis) (default) = 1, DDNA (divided difference noise analysis)
12-14	I3	Maximum number of internal edit loops for a given order (difference level) of noise determination < 0, do not perform any editing = 0, use default value (default = 3)
15-17	I3	Maximum order allowed < 0, do not perform noise evaluation (set noise statistics equal to calibration statistics if latter are generated) = 0, use default value (default = 9)
18-38	G21.14	Selection specifications TTMR; identical to definition for columns 18-38 of Aƀƀƀ****' card
39-59	G21.14	Convergence criteria (order level) constant = 0, use default value (default = 0.10) (value C outside range 0.0 C 1.0 is not defined)
60-80	G21.14	Sigma edit criterion used for internal edit loops

NOMBOUND

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	NOMBOUND--keyword to set the nominal truncation error bound for step size control
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Nominal truncation error bound for section I
39-59	G21.14	Nominal truncation error bound for section J
60-80	G21.14	Nominal truncation error bound for section K

A maximum of 10 flight sections is allowed.

The initial value of the nominal error bound for all sections can be set to the same value by using the TOLER keyword card, at the user's option. This value is overridden for specified flight sections by using the NOMBOUND keyword card.

NPQPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	NPQPAR--keyword to set Brouwer (drag coefficients) $N_{p,q}$ values, and solve for switches
9-11	I3	$N_{p,q}$ solve for indicator: = 1, do not solve for (only apply the a priori $N_{p,q}$ value) = 2, solve for and apply $N_{p,q}$s = 3, solve for and apply $N_{p,q}$s from retrieved values. (Values from columns 18 through 38 and 39 through 59 are ignored.)
12-14	I3	Value of p of $N_{p,q}$ (see Note 1) = 2, first order = 3, second order
15-17	I3	Value of q of $N_{p,q}$ (see Note 1) = 0, 1, ..., or 13
18-38	G21.14	Time to start applying this $N_{p,q}$ YYMMDDHHMMSS.SSS (see Note 2)
39-59	G21.14	A priori value of $N_{p,q}$ (default = 0.0)
60-80	G21.14	Time to start applying $N_{p,q}$ in a DC Program run with advanced epoch time or in an EPHEM Program run (see Note 3)

NOTES:
1. A maximum of 14 NPQPAR cards can be included with any combination of p = 2, 3 in ascending order and also q = 0, 1, 2, ..., 13 in ascending order.
2. For the DC case only, the field is left blank in the EPHEM case.
3. If there is no epoch advance, this field must be identical to R1 field (columns 18 through 38).

OASENSOR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	OASENSOR--keyword that sets attitude sensor data values and options
9-11	I3	Determine true-Earth horizon crossings: = 1, yes (default) = 2, no
12-17		Blank
18-38	G21.14	Spin rate of satellite (revolutions per minute) (default = 7.155 for the Small Scientific Satellite (SSS))
39-59	G21.14	Sensor mounting angle (degrees) (default = 134.6 for the SSS)
60-80	G21.14	Time rate at which to call subroutine ODAP to determine the true-Earth horizon crossings pattern (seconds) (default = 300.0)

OBSCORR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	OBSCORR--keyword to set observation correction parameters
9-11	I3	Frequency at which observation corrections are updated by iteration (default = 0, no corrections are applied)
12-14	I3	Iteration number at which the first set of observation corrections are recomputed (default = 1)
15-17	I3	Integration indicator used in conjunction with the Bent Ionospheric Model: = 0, use analytic calculation (default) = 1, use numerical integration = 2, include effects of ionospheric gradients for refraction corrections
18-38	G21.14	Packed word (see Note 1) for correction request for all stations (default = 22222.0)
39-59	G21.14	Minimum angle for refraction correction calculations (default = 6.0 degrees)
60-80	G21.14	Packed word (see Note 2) for overriding observation correction flags in each 60-byte observation record (default = 22222.0)

NOTES: 1. A 5-digit number IJKLM (I = light time correction, J = ionospheric correction, K = tropospheric refraction correction, L = antenna refraction correction, M = transponder delay correction) sets the corrections switches for ALL stations. A value of 1 implies the correction will be made; a

value of 2 implies the correction will not be made. If it is desired to change the correction settings for given stations, station 6 cards must be used to override the packed word.

The two models in GTDS for computing the refraction corrections are the Bent model and the Novak model. The default model is the Bent model. The user can override the default through proper input on a WORKIONO keyword card in a DMOPT subdeck. If the ionospheric refraction switch is turned on, a WORKIONO keyword card is required to build an Ionospheric Refraction Working File.

2. Currently, only the tropospheric refraction correction flag can be overridden. When a tropospheric refraction correction is requested and this field is ignored or set to 22222.0, the correction will be made only if the flag in the 60-byte observation record indicates that the correction has not been made at the preprocessing stage. (For 60-byte laser data, a tropospheric refraction correction has normally already been made in the preprocessing stage.)

   When a tropospheric refraction correction is requested and this field is set to 22122.0, the refraction correction flag is overridden and the tropospheric refraction correction is applied regardless of the value of the flag. The user should be aware that setting this field to 22122.0 could result in a correction being applied to data that have already been corrected.

OBSDEV

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	OBSDEV--keyword to set the input observation noise standard deviation for observations in the 60-byte format when the SOR is not requested and for observations in the 100-byte format
9-11	I3	Weight index I
12-14	I3	Weight index J
15-17	I3	Weight index K
18-38	G21.14	Noise standard deviation for weight index I (See Appendix A, Table A-2, for the weight index and default values.)
39-59	G21.14	Noise standard deviation for weight index J (See Appendix A, Table A-2, for the weight index and default values.)
60-80	G21.14	Noise standard deviation for weight index K (See Appendix A, Table A-2, for the weight index and default values.)

Units are meters for range, centimeters per second for range rate, hertz for ATSR coherent and relay range rate, seconds of arc for angles, and cosine values for minitrack angles.

OBSINPUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	OBSINPUT--keyword to specify observations input sources
9-11	I3	Source of input observations
12-14	I3	Source of input observations
15-17	I3	Source of input observations
18-38	G21.14	Start time of observations span (yymmddhhmmss.ssss) (default = run epoch)
39-59	G21.14	End time of observations span (yymmddhhmmss.ssss) (default = run epoch plus 3 months)
60-80	G21.14	Satellite ID for second satellite (applicable only when processing ATS satellite-to-satellite tracking data)

There are no default input observation sources. Any desired source must be specified. If more than three sources are required, multiple OBSINPUT cards must be used. There are two options for entering observation sources. Option 1 is used when there is no SST involved. Option 2 is used when the case involves SST. The two options can be intermixed, but only one indicator from option 2 may be used on any set of OBSINPUT cards. No source number may be used in both options. this card must not be used in any program input deck that contains a WORKOBS keyword card in the DMOPT subdeck. The source numbers for options 1 and 2 follow.

Option 1

Source Number	Source	Number	Source
1	GTDS observations tape (FT29)	7	G-WWW tape, 9-track (FT40)
2	GTDS observations disk (FT31)	8	60-byte data base (FT96)
3	DODS observations tape (FT30)	9	PCE ORB1 tape (FT24)
4	Real-time 60-byte metric tracking data file (partial batch)	10	Landmark data card file (FT15)
5	GTDS card file (FT15)	11	Observations working file previously created (FT17)
6	Attitude sensor (optical aspect) nine-track tape (FT94)	12	Generalized Data Handler (GDH) 60-byte format tape (FT91)

Option 2

Option 2 must be used whenever

1. Satellite-to-satellite tracking for ATS is involved
2. TDRS tracking data is involved (this includes satellite-to-satellite data, relay tracking of ground transponders, and direct tracking of a TDRS relay satellite):

a. ATS--the source indicator IJK is a packed integer

where I indicates source of the satellite-to-satellite relay data

J indicates source of ATS tracking data

K indicates source of target satellite tracking data

b. TDRS--the source indicator IJK is a packed integer

where I indicates source of the satellite-to-satellite relay data and relay-ground tracking

J indicates source of direct tracking of the TDRS relay satellites

K indicates source of target satellite tracking data

The following source numbers apply to I, J, and K:

Source Number	Source
1	No data of this type
2	GDH tape (FT91)
8	60-byte data base (FT96)

Specifying a 1 in any integer means that data will not be searched for on any input source.

Examples

Column 1	11	20	40
OBSINPUT	818	start time	end time

Option 2 (Cont'd)

Specifies that ATS or TDRSS satellite-to-satellite data will be found on the 60-byte data base (source 8), there will be no direct tracking of the relay satellites requested, and the source of the direct tracking of the target satellite will be the 60-byte data base.

Column 1	11	20	40
OBSINPUT	818	start time	end time

Specifies that ATS or TDRSS satellite-to-satellite data will be found on the 60-byte observation tape (source 2) and there will be no direct tracking of either the relays or target satellite.

NOTE: The use of real-time 60-byte (source number 4) data must be indicated under Option 1. Source number 4 is not a valid entry under Option 2; real-time tracking data for a TDRS run may be obtained by intermixing Option 2 and Option 1, with source number 4 specified. More specific control over the real-time data source is provided by the keyword cards RTPARAMS, RTSATID, RSTA****, and RSYS****.

OBSNUME[1]

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	OBSNUME--keyword to select observation numbers for the EARLYORB Program (see Note)
9-11	I3	GTDS observation type
12-14	I3	GTDS observation type
15-17	I3	GTDS observation type
18-38	G21.14	Observation time (yymmddhhmmss.ssss)
39-59	G21.14	Observation time (yymmddhhmmss.ssss)
60-80	G21.14	Observation time (yymmddhhmmss.ssss)

NOTE: See the OBSINPUT keyword card for the observation source selection. The minimum number of observations is six and the maximum is 48.

OGOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	OGOPT--keyword to initiate the OGOPT subdeck
9-80		Blank

The OGOPT subdeck can contain the following optional keyword cards:

APOFOCAL	DRAGPOLY	MAXSECT	RTASCVAR
ATMOSDEN	EPHQLCRT	MEANEL	SCPARAM
ATTANG1	FLATCOEF	NCBODY	SCPARAM2
ATTANG2	GMCON	NOMBOUND	SHELLRAD
ATTANG3	HARMONIC	NPQPAR	SNM
ATTPAR	HISTPLOT	OUTBODY	SOLRAD
AUTOFORC	HSTSCALE	OUTCOORD	SOLRDPAR
AVERAGE	IMPULSE	OUTOPT	SPHERE
BDROTATE	INTEG	OUTPART	SPHINF
BODYRAD	INTEROUT	OUTTYPE	STATEPAR
CBODY	INTMODE	PICBIAS	STATETAB
CNM	LNDPAR	POLAR	STEPSIZE
COVARNC	LOWBOUND	POTFIELD	THRSTCOF
DECLVAR	MANMASS	RAPRIME	THRSTPAR
DISTCB	MANTIME	RATIME	THRSTVAR
DISTNCB	MAXDEGEQ	RCACB	THRUST
DRAG	MAXDEGVE	RCANCB	TIMES
DRAGCOF	MAXORDEQ	RESTART	TIMREG
DRAGPAR	MAXORDVE	ROLLVAR	TIMREGDV

OGOPT
(subdeck identifier)

TITLE	TOLER	UPPBOUND
TOF	TWOBODY	VAREPHEM

The OGOPT subdeck must terminate with an END keyword card.

The OGOPT subdeck must precede the DCOPT subdeck in a DATASIM or an ANALYSIS run.

ORBTYPE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC,
- Detailed format:

Columns	Format	Description
1-8	A8	ORBTYPE--keyword to select the orbit generator type
9-11	I3	Orbit generator type (See Table 4-5 for types and additional options.)
12-14	I3	See Table 4-5
15-17	I3	See Table 4-5
18-38	G21.14	See Table 4-5
39-59	G21.14	See Table 4-5
60-80	G21.14	See Table 4-5

Notes for ORBTYPE options are as follows:

- o Integration step modes:

  1 - Fixed step (default)

  2 - Regular variable step

  3 - Shell mode variable step (not available for VOP orbit generators)

  4 - Halving-doubling

  Tolerance for the automatic variable step options (2 - regular variable step, and 4 - halving-doubling) are specified by the TOLER, LOWBOUND, UPPBOUND, and NOMBOUND keywords.

  The radial distances and corresponding step sizes for the semiautomatic variable step option (3 - shell mode variable step) are specified on the SHELLRAD card.

Table 4-5. ORBTYPE Keyword Card Contents

COLUMN	FORMAT	DESCRIPTIONS 1	2	3	4	5	6	7	8	9	10	11	12	13	14
9-11	I3	TIME-REGULARIZED COWELL = 1	COWELL (DEFAULT = 2)	BROUWER = 3	BROUWER-LYDDANE = 4	VARIATION OF PARAMETERS (VOP) = 5	PREGENERATED ORBIT FILE = 6	—	—	CHEBYSHEV SERIES INTEGRATOR = 9	—	—	VINTI = 12	HULL RUNGE-KUTTA = 13	NOMINAL EPHEMERIS = 14*
12-14*	I3	INTEGRATION STEP MODE	INTEGRATION STEP MODE	—	—	INTEGRATION STEP MODE	LEVEL OF ORBIT FILE = 0 (ZERO) FOR SEQUENTIAL	—	—	INTEGRATION STEP MODE	—	—	--	INTEGRATION STEP MODE	—
15-17*	I3	COORDINATE SYSTEM ORIENTATION	COORDINATE SYSTEM ORIENTATION	COORDINATE SYSTEM ORIENTATION	COORDINATE SYSTEM ORIENTATION	COORDINATE SYSTEM ORIENTATION	FRN OF THE ORBIT FILE	—	—	COORDINATE SYSTEM ORIENTATION	—	—	COORDINATE SYSTEM ORIENTATION	COORDINATE SYSTEM ORIENTATION	—
18-38	G21.14	NUMBER OF STEPS PER REVOLUTION (DEFAULT = 200)	INTEGRATION STEPSIZE IN SECONDS (DEFAULT = 24)	—	—	INTEGRATION STEPSIZE IN SECONDS (DEFAULT = 24)	—	—	—	ARC LENGTH (i.e., STEPSIZE) IN SECONDS (DEFAULT = 5400)	—	—	—	INTEGRATION STEPSIZE IN SECONDS	—
39-59	G21.14	—	—	—	—	—	—	—	—	ORDER OF CHEBYSHEV POLYNOMIAL (DEFAULT = 38)	—	—	—	—	—
60-80*	G21.14	TIME REGULARIZATION CONSTANT (DEFAULT = 1.5)	—	—	—	TYPE OF VOP PARAMETER	—	—	—	TOLERANCE (DEFAULT = 10^{-6} KM)	—	—	—	—	—

*SEE NOTES TO THESE OPTIONS

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- Coordinate system orientation

  1 - Mean equator and equinox of 1950.0 (default)

  2 - True of reference (Precession and nutation are ignored in coordinate transformations during integration. Therefore, this coordinate system orientation is only desirable when the integration span is short and the span is in proximity to the reference date (see Reference 2, page 3-18).

  3 - Mean equator and equinox of J2000.0 (see Note)

- Time regularization constant (n)--The types of independent variables in time regularization are defined by

$$\frac{dt}{ds} = \frac{r^n}{m} \qquad 1 \leq n \leq 2$$

  Where n = 1 indicates the independent variable is related to the eccentric anomaly and

  n = 2 indicates true anomaly.

- Type of VOP parameter:

  1 = Dallas

  2 = equinoctial (mean longitude)

  3 = equinoctial (eccentric longitude)

  4 = Ideal (true longitude)

  5 = Ideal (eccentric longitude)

  6 = Kustaanheimo-Stiefel (KS)

  7 = Delaunay-Similar (DS)

  8 = Keplerian

  12 = averaged equinoctial

  18 = averaged Keplerian

- Level of PTOF

  -1--Use level with latest possible start time

  Other--Use level specified (cannot be zero or blank)

NOTE: Only one level is used for the EPHEM program; more than one level may be used for the DC program. For the DC program, the level number specified is the first (earliest) level used.

- FRN of PTOF

  Must be 71, 72, or 73

SPECIAL NOTES FOR TDRSS DC PROGRAM RUNS:

Currently only the time-regularized Cowell and Cowell orbit generators are available for the user satellite. A scratch ORBIT File will be created on FORTRAN Unit 80, using one of those orbit generators (see the TDRORB keyword card for more information). The coordinate system orientation specified in columns 15 through 17 will be used to create all scratch ORBIT Files in a TDRSS DC Program run (user satellite and relay satellite ORBIT Files). The scratch ORBIT File for the user satellite will be created with partial derivatives by default. Therefore, no JCL overrides are needed for unit 80. (See the TDRORB keyword card for more information.)

SPECIAL NOTE FOR NOMINAL EPHEMERIS OPTION (OPTION=14):

The nominal ephemeris file must be placed on FRN 24 in the JCL.

SPECIAL NOTE FOR INTEGRATION IN J2000.0 COORDINATE SYSTEM:

The J2000.0 SLP file must be attached to FT14 to integrate in the J2000.0 system. If this is not done, the integration coordinate system will default to the coordinate system of the SLP file.

OUTBODY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	OUTBODY--keyword to set additional optional output reference bodies by flight sections
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Indicator for reference bodies for libration coordinates outputs when Earth is the central body of integration. For the DC Program a number greater than or equal to 16 for flight section one or any other section will generate libration coordinates as well as central body outputs. If the number is less than 16, only the central body output will be printed.

OUTCOORD

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	OUTCOORD--keyword to set the output coordinate system to orientation by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Indicator for the output coordinate system orientation for section I: = 1, mean Earth equator and equinox of 1950.0 = 2, true of date or true of reference (see Note) = 3, true of date or true of reference, body-fixed (see Note) = 4, mean ecliptic and equinox of 1950.0 = 5, true ecliptic and equinox of date = 6, mean Earth equator and equinox of 1950.0 and true of reference or true of date (see Note) = 7, mean Earth equator and equinox of J2000.0
39-59	G21.14	Indicator for the output coordinate system orientation for section J: = 1, mean Earth equator and equinox of 1950.0 = 2, true of date or true of reference (see Note) = 3, true of date or true of reference, body-fixed (see Note) = 4, mean ecliptic and equinox of 1950.0 = 5, true ecliptic and equinox of date = 6, mean Earth equator and equinox of 1950.0 and true of reference or true of date (see Note) = 7, mean Earth equator and equinox of J2000.0

Columns	Format	Description
60-80	G21.14	Indicator for the output coordinate system orientation for section K: = 1, mean Earth equator and equinox of 1950.0 = 2, true of date or true of reference (see Note) = 3, true of date or true of reference, body-fixed (see Note) = 4, mean ecliptic and equinox of 1950.0 = 5, true ecliptic and equinox of date = 6, mean Earth equator and equinox of 1950.0 and true of reference or true of date (see Note) = 7, mean Earth equator and equinox of J2000.0

A maximum of 10 flight sections is allowed.

NOTE: This output will be TOD if integrating in the 1950.0 system; otherwise, it will be in the true-of-reference system.

OUTOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	OUTOPT--keyword to select ephemeris output
9-11	I3	Type of ephemeris file to be generated (see Note 1): = 0, ORBIT File on primary unit (see Note 1) = 1, ORB1 File (9 track) on primary unit = 2, ORB1 File (9 track) and ORBIT File on primary units = 3, EPHEM File on primary unit (see Note 2) = 4, ORBIT File and EPHEM File on primary units = 5, Ephemeris Data File Preparation (EDFP) File (see Note 3) = 20, ORBIT File on secondary unit = 21, ORB1 File (9 track) on secondary unit = 22, ORB1 File (9 track) and ORBIT File on secondary units (see Note 2) = 23, EPHEM File on secondary unit = 24, ORBIT File and EPHEM File on secondary units (see Note 2) = 97, direct access input/output (DAIO) ORBIT File on unit 97 (see Note 4) = 98, DAIO ORBIT File on unit 98 (see Note 4) = 99, DAIO ORBIT File on unit 99 (see Note 4) = 197, ORB1 File on primary unit and DAIO ORBIT File on unit 97 (see Note 4)

Columns	Format	Description
9-11 (Cont'd)		= 198, ORB1 File on primary unit and DAIO ORBIT File on unit 98 (see Note 4) = 199, ORB1 File in primary unit and DAIO ORBIT File on unit 99 (see Note 4) = 397, EPHEM File on primary unit and DAIO ORBIT File on unit 97 (see Note 4) = 398, EPHEM File on primary unit and DAIO ORBIT File on unit 98 (see Note 4) = 399, EPHEM File on primary unit and DAIO ORBIT File on unit 99 (see Note 4)
12-14	I3	For ORBIT File (i.e., when value in columns 9 through 11 is 0, 2, 4, 20, 22, 24, 97, 98, 99, 197, 198, 199, 397, 398, 399), partial derivatives switch (see Note 1): = 1, partial derivatives are included = 2, partial derivatives are not included (default) For EPHEM File (i.e., when the value in columns 9 through 11 is 3 or 23), central body indicator (see Appendix B for body numbers)(See also Note 6)
15-17	I3	For ORBIT Files (i.e., when the value in columns 9 through 11 of this card is 0, 2, 4, 20, 22, 24, 97, 98, 99, 197, 198, 199, 397, 398, 399) (see Note 1): = 0, sequential ≠ 0, indicates the level of direct access file to be generated For EPHEM Files (i.e., when the value of columns 9 through 11 of this card is 3 or 23), the coordinate frame indicator (See Notes 5 and 6): = 1, mean of 1950.0 = 2, TOD or true-of-reference (default) = 3, mean Earth equator and equinox of J2000.0

Columns	Format	Description
18-38	G21.14	Start time of arc (yymmddhhmmss.ssss)
39-59	G21.14	End time of arc (yymmddhhmmss.ssss)
60-80	G21.14	Output interval for ORB1 or EPHEM File in seconds (default = 60 seconds)

NOTES: 1. The ORBIT File will be referenced to the same central body and coordinate system as the integrator. The primary unit is the standard unit assignment when any output ephemeris file is needed. The secondary unit is used when a file is being generated for immediate use in the COMPARE Program. The FRNs for the files are as follows:

Primary Unit	Secondary Unit	File
19	86	ORBIT disk file with partial derivatives
20	88	ORBIT disk file without partial derivatives
21	82	ORBIT tape file with partial derivatives
22	84	ORBIT tape file without partial derivatives
24	81,83,85 87	ORB1 or EPHEM File
54	None	EDFP File

2. In stacked cases when multiple EPHEM files are generated, the FRN is circularly updated with each case starting with unit 24, then 81 followed by 83, 85, 87.

   The user may specify the first unit to be written as unit 81 by setting the secondary EPHEM indicator.

3. The EDFP File is an ephemeris data file for the PDP-11 computer. Further description of this option can be found in Section 3.1.7.3 of this document.

4. These options are valid for the EPHEM program only. The ORBIT File will be created by using the DAIO package. Since units 97, 98, and 99 are used for the scratch ORBIT Files and the end of DC Program output ORBIT Files in a TDRSS DC Program run, the OUTOPT card with the DAIO file options should not be used in a DC Program run. See the TDRFILES keyword description for the creation of the end of DC Program output ORBIT Files.

5. The EPHEM File defaults to Earth-centered true-of-date if the coordinate system orientation of the integrator specified on the ORBTYPE keyword card is near the equator and equinox of 1950.0, or will default to Earth-centered true-of-reference if the coordinate system orientation of the integrator is true-of-reference.

6. When on EPHEM file is written with an ORBIT or ORB1 file (i.e., when the value in columns 9 through 11 is 4, 24, 397, 398, 399), the value in columns 12 through 14 is the partial derivative switch and the central body indicator for the EPHEM file defaults to 1 (Earth). Similarly, the value in columns 15 through 17 is taken as the ORBIT file organization indicator and the coordinate frame indicator for the EPHEM file defaults to 2 (true-of-date or true-of-reference).

OUTPART

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	OUTPART--keyword to set the output for state partial derivatives by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Partial derivative output option for section I: = 1.0, print partial derivatives of Cartesian state with respect to parameters (default) = 2.0, print partial derivatives of Keplerian state with respect to parameters = 3.0, print partial derivatives of spherical state with respect to parameters
39-59	G21.14	Partial derivative output option for section J: = 1.0, print partial derivatives of Cartesian state with respect to parameters (default) = 2.0, print partial derivatives of Keplerian state with respect to parameters = 3.0, print partial derivatives of spherical state with respect to parameters

Columns	Format	Description
60-80	G21.14	Partial derivative output option for section K: = 1.0, print partial derivatives of Cartesian state with respect to parameters (default) = 2.0, print partial derivatives of Keplerian state with respect to parameters = 3.0, print partial derivatives of spherical state with respect to parameters

Entering 1.0, 2.0, or 3.0 in the real fields (G21.14) will set the switch so that any partial derivatives computed by the orbit generator will be printed for that particular section. For example, entering 2.0 will print partial derivatives of Keplerian state with respect to DC Program solve-for or consider parameters.

This keyword is valid only with the Cowell integrator.

OUTPUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	OUTPUT--keyword to specify orbit generator printer output
9-11	I3	Output coordinate system orientation: = 1, mean Earth equator and equinox of 1950.0 = 2, true-of-reference or TOD (inertial) (default) = 3, true-of-reference or TOD (body-fixed) = 4, mean ecliptic and equinox of 1950 = 5, TOD, ecliptic, and equinox = 6, mean Earth equator and equinox of 1950.0 and true-of-reference or TOD (inertial) = 7, mean Earth equator and equinox of J2000.0 = 8, mean Earth equator and equinox of J2000.0 and true-of-reference or TOD (inertial) = 9, mean Earth equator and equinox of B1950; mean Earth equator and equinox J2000.0 and true-of-reference or TOD (inertial) = 10, mean Earth equator and equinox of B1950; mean Earth equator and equinox J2000.
12-14	I3	Output reference system:* = 1, Cartesian (position, velocity, latitude, longitude, height) = 2, Cartesian, Keplerian, and spherical (default)

*When Ephemeris Elements History Plots are requested, this field must be set to 2.

Columns	Format	Description
		= 3, Cartesian, Keplerian, spherical and mean (osculating instead of mean when using the VOP integrator averaging types; Earth-centered output only)
		This field may take the form LMN where L indicates perigee/apogee passage printout (column 12), M indicates special nodal crossing printout (column 13), and N is defined above:
		L = 0, no printout = 1, print perigee passage time = 2, print apogee passage time = 3, print both passage times

OUTPUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
		M = 0, no printout = 1, print at ascending nodes = 2, print at descending nodes = 3, print at ascending and descending nodes
15-17	I3	Output reference body (other than central body) (see Note): = 1, Earth = 2, Sun = 4, Moon = 8, target body (defined as central body of the final section) = 16, libration coordinates
18-38	G21.14	Year, month, day of end of print arc (yymmdd.0)
39-59	G21.14	Hours, minutes, seconds of end of print arc (hhmmss.ssss)
60-80	G21.14	Output print interval (seconds) or nodal print frequency if column 13 0 (i.e., print every Nth crossing)

The start time of the print arc is the epoch by default, or it can be set using the keyword card TIMES in the OGOPT subdeck.

The initial output coordinate system orientation, output coordinate system type, and output reference body will be used for all flight sections unless overridden by the OUTCOORD, OUTTYPE, and OUTBODY keyword cards, respectively.

When the coordinate system orientation used in the integration is true-of-reference (as specified in columns 15 through 17 of the ORBTYPE keyword), the output coordinate system orientation will be true-of-reference if a value of 2 (default) or 3 is entered in columns 9 through 11 on the OUTPUT keyword card. Consequently, the precession and nutation will be ignored in the output. If the TOD coordinate system orientation is desired for the output, the coordinate system orientation for the integration specified on the ORBTYPE keyword card must be mean equator and equinox of 1950.0.

NOTE: Any combination of these bodies can be obtained if an inertial coordinate system is specified by summing the associated numeric codes (e.g., 5 = Earth-centered and lunar-centered output).

OUTTYPE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	OUTTYPE--keyword to set the printer output reference system by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Output coordinate system type for section I: = 1, Cartesian = 2, Cartesian, Keplerian, and spherical (default)
39-59	G21.14	Output coordinate system type for section J:
60-80	G21.14	Output coordinate system type for section K: = 1, Cartesian = 2, Cartesian, Keplerian, and spherical (default)

A maximum of 10 flight sections is allowed.

PARTRTMS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	PARTRTMS--keyword to specify options for the Partial Tracking Report (valid only in the consider mode)
9-11	I3	Partial tracking standard deviation breakdown to be made: = 1, yes = 2, no (default)
12-14	I3	Coordinate system of sensitivity breakdown: = 1, Cartesian (default) = 2, Keplerian = 3, orbit plane
15-17		Blank
18-38	G21.14	Partial tracking report start time (yymmddhhmmss.ssss)
39-59	G21.14	Partial tracking report end time (yymmddhhmmss.ssss)
60-80	G21.14	Partial tracking time interval in seconds (no default)

PASSTIME

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	PASSTIME--keyword to define a pass for pass-dependent biases
9-11	I3	Pass type: = 0, pass-dependent biases = 1, specified length from start of observation
12-17		Blank
18-38	G21.14	Pass definition in seconds (time between successive observation for any station) (default = 10.D16)
39-80		Blank

PFROPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	PFROPT--keyword to specify processing of the PFROPT subdeck
9-80		Blank

The PFROPT subdeck can contain the following optional keyword cards:

ATMOSRPT	EPOTRPT	MANURPT
CONSTRPT	GEODRPT	SECTRPT
ELSRPT	INTCPRT	SLPRPT
ELS24RPT	LPOTRPT	SLPELRPT

The PFROPT subdeck must terminate with an END card. Only one of each keyword card is allowed per PFROPT subdeck except ATMOSRPT for which two are allowed.

SLPELRPT may only be used in an EPHEM run when an SLP working file is created.

PICBIAS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	PICBIAS--keyword to set landmark camera/ picture biases options
9-11	I3	Bias option: = 1, solve for bias using prestored value = 2, solve for bias using updated value in columns 18-38 = 3, update prestored parameter value
12-14	I3	Bias indicator: = 1, 2, 3, 4, or 5 (see Note)
15-17		Blank
18-38	G21.14	A priori bias value in degrees (bias 5 in seconds)
39-68	G21.14	Blank
69-80	G21.14	Standard deviation in degrees (bias 5 in seconds)

NOTE: The PICBIAS bias indicators are defined as follows:

Bias Indicator	Landmark (Spinning Data)	Landmark (Three-Axis Stabilized Data)
1	Camera elevation (α'_o)	Camera misalignment angle (α'')
2	Roll angle ($\Delta\gamma_o$)	Camera misalignment (β'')
3	Spin axis cone (θ)	Camera misalignment angle (γ'')
4	Spin axis roll (ϕ_o)	
5	Timing (Δt)	Timing (Δt)

POLAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	POLAR--keyword to set polar motion option switch for each flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Polar motion option for section I
39-59	G21.14	Polar motion option for section J
60-80	G21.14	Polar motion option for section k

Entering 1.0D0 in the G21.14 fields will cause polar motion data to be included in the rotation from Earth-centered to body-fixed coordinates. The default value is 2.0D0, which indicates no polar motion will be modeled.

A maximum of 10 flight sections is allowed.

POTFIELD

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	POTFIELD--keyword to indicate if retrieval of potential field data is required (see Note 1)
9-11	I3	Body for which field is to be retrieved: = 1, Earth = 2, Moon
12-14	I3	Potential field model number (see Note 2)
15-80		Blank

NOTES: 1. At the time of publication of this document, it was necessary to include the following JCL after all GTDS procedure overrides:

```
//GO.FT48F001 DD DSN = &POTFLD, UNIT = DISK,
//    SPACE = (4200,2), DISP = (,DELETE),
//    DCB = (DSORG=DA,BUFNO=1)
```

2. See Appendix D, Item A, for model number (if the body indicated in columns 9 through 11 is the Earth); see Appendix D, Point B, for model number (if the body indicated in columns 9 through 11 is the Moon).

PRESERCH

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	PRESERCH--keyword to specify preliminary orbit search parameters.
9-11	I3	Perform search if set to 1; don't perform search if 0 (default: don't perform search)
12-14	I3	Number of search levels to perform (between 0 and 8; default = 2)
15-17	I3	Spare
18-38	G21.14	Estimate of spacecraft height in kilometers at the time of the second observation (default = 1000 km)
39-59	G21.14	Search rate parameter (default = 1.25)
60-80	G21.14	Minimum accuracy to terminate search (default = 0.2)

PRINTOUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	PRINTOUT--keyword to set the Observation Residual Report frequency and plot options
9-11	I3	= n, This field must be used in conjunction with DC Program Print Control Indicator. (This field not valid unless third integer field equals 5.) The Observation Residual Report will be generated to the printer every nth iteration (default = 1, i.e., output every iteration, see Note 1)
12-14	I3	= m, the Observation Residual Report will be generated to the graphics display device every mth iteration (m must be a multiple of n, default = 1, i.e., output every iteration)
15-17	I3	DC Program print control indicator (see Table 4-6, default = 5)
18-38	G21.14	Sum of desired plot types (see Note 2)
39-80		Blank

NOTES: 1. This option is only valid when the DC Program print control indicator equals 5. When this option is used, residual printout will always occur for the first and last iterations. After the first iteration, printout will occur every nth iteration as specified in this field.

2. Available plot types and their codes are as follows: each observation type for all stations in DC Program = 1; each observation type for each station in DC Program = 10; particular observation type for a particular station (defined through keyword card /*******3), = 100. Any combination of these plots may be obtained by requesting the sum of the desired plot codes. See the table on the next page for the necessary JCL.

Table 4-6. DC Program Print Control

	Value of Print Flag				
Report	1	2	3	4	5
DC Initial Conditions Report	All	All	All	All	All
Observation Residual Report	None	None	1 & ℓ	1 & ℓ	All
Variance-Covariance Matrix Report	None	None	None	1 & ℓ	All
Current Elements Report	None	ℓ	1 & ℓ	1 & ℓ	All
Solve-For Parameter Report	None	ℓ	1 & ℓ	1 & ℓ	All
End-of-Iteration Summary Report	None	None	1 & ℓ	1 & ℓ	All
DC Summary Report	ℓ	ℓ	ℓ	ℓ	ℓ
Orbital Elements Report	ℓ	ℓ	ℓ	ℓ	ℓ

For flag values 1 through 5, the reports will be printed at completion of the indicated iterations (where ℓ is the last iteration).

The required JCL for DC residual plots is as follows:

```
//GO.FT42F001 DD DSN=&PLOT,UNIT=DISK,DISP=(,PASS),
//    DCB=(RECFM=VBS,LRECL=136,BLKSIZE=1636),
//    SPACE=(CYL,(5,1),RLSE)
```

RAMB****

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	RAMB****--keyword to override the small range ambiguity for SRE data where asterisks represent the station acronym (see Appendix A for station acronyms). If the same range ambiguity is to be input for all stations employing the same tracker type, "ALLX" can be used instead of a station acronym, where X specified the tracker types (see Table 4-2 for values of X). If blanks are specified for the station acronym, the overriding small range ambiguity will be applied to all stations.
9-17		Blank
18-38	G21.14	Small range ambiguity kilometers (default = 14989.625 kilometers for all SRE trackers)
38-80		Blank

Currently, this keyword is applicable to SRE S-Band and VHF trackers. However, USB trackers can also be input, if their tracking system indicator is SRE type. A maximum of 20 cards is allowed. If the first real field (columns 18 through 38) is zero or blank, a value of 0.0 will be entered as small range ambiguity.

RAMBOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	RAMBOPT--keyword to select the SRE range ambiguity computation option
9-11	I3	Option value: = 1, compute small ambiguities only = 2, compute large ambiguities only = 3, compute both "1" and "2"; take the minimum (default) = 4, compute large ambiguities and refine with multiples of small ambiguity = 5, compute both "1" and "4" and take the minimum = 6, no ambiguity computations made
12-80		Blank

RAPRIME

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	RAPRIME--keyword to set the right ascension of the prime meridian of the specified body
9-11	I3	Index of body I
12-14	I3	Index of body J
15-17	I3	Index of body K
18-38	G21.14	Right ascension (degrees) of prime meridian for body I
39-59	G21.14	Right ascension (degrees) of prime meridian for body J
60-80	G21.14	Right ascension (degrees) of prime meridian for body K

The body indexes given on this card must be greater than 3 and less than 12. They must agree with those on the RATIME card. See Appendix B for the body indexes.

RATIME

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	RATIME--keyword to set time associated with right ascension of prime meridian of specified body
9-11	I3	Body index I
12-14	I3	Body index J
15-17	I3	Body index K
18-38	G21.14	Time of right ascension for body I (seconds from epoch)
39-59	G21.14	Time of right ascension for body J (seconds from epoch)
60-80	G21.14	Time of right ascension for body K (seconds from epoch)

The body indexes as given on this card must be greater than 3 and less than 12. They must agree with those on the RAPRIME card. See Appendix B for the body indexes.

RCACB

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	RCACB--keyword to set the radius of closest approach (RCA) sectioning switch for a central body
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	RCA switch for section I (see Note)
39-59	G21.14	RCA switch for section J (see Note)
60-80	G21.14	RCA switch for section K (see Note)

The central bodies must be specified with the keyword CBODY. A maximum of 10 flight sections is allowed.

NOTE: A value of 1.0 will set the switch to change section on radius of closest approach and a value of 2.0 will turn the switch off. The default value is 1.0.

RCANCB

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	RCANCB--keyword to set the radius of closest approach (RCA) for the next central body sectioning conditioning
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	RCA switch for the next central body for section I (see Note)
39-59	G21.14	RCA switch for the next central body for section J (see Note)
60-80	G21.14	RCA switch for the next central body for section K (see Note)

The central bodies must be specified with the CBODY keyword card. A maximum of 10 flight sections is allowed.

NOTE: A value of 1.0 will set the switch to change section on radius of closest approach to the next central body, and a value of 2.0 will turn the switch off. The default value is 1.0.

RELAYID

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	RELAYID--keyword to specify the ATS relay satellite identification number
9-17		Blank
18-38	G21.14	Relay satellite identification number
39-80		Blank

RESTART

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	RESTART--keyword to set the integration starter option
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Restart option for section I (see Note)
39-59	G21.14	Restart option for section J (see Note)
60-80	G21.14	Restart option for section K (see Note)

A maximum of 10 flight sections is allowed.

NOTE: A value of 1.0 will cause the multistep starter to be used; a value of 2.0 will cause the Runge-Kutta starter to be used. The default is the multistep starter (1.0). Note that only the Runge-Kutta starter can be used for time-regularized Cowell integration method.

ROLLVAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	ROLLVAR--keyword to set the a priori standard deviations of roll coefficients for an Earth-stabilized spacecraft (For a description of the meanings of the five roll coefficients, see the ATTANG3 keyword card description.)
9-11	I3	Number of standard deviation values to be read in (from 1 to 5)
12-17		Blank
18-38	G21.14	A priori standard deviation of first roll coefficient in degrees
39-59	G21.14	A priori standard deviation of second roll coefficient in degrees per second
60-80	G21.14	A priori standard deviation of third roll coefficient in degrees per second

To input additional roll standard deviations, place a second card with the standard deviation of the fourth and fifth coefficients in the first and second real fields (columns 18 through 38 and 39 through 59). The default value for all a priori standard deviations is infinity (∞).

RTASCVAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	RTASCVAR--keyword to set a priori standard deviation of right ascension or yaw coefficients when used with landmark data (The coefficients are for right ascension or yaw, depending on the third integer field of the ATTANG1 keyword case.)
9-11	I3	Number of standard deviation values to be read in (from 1 to 5)
12-17		Blank
18-38	G21.14	A priori standard deviation of the first coefficient (degrees)
39-59	G21.14	A priori standard deviation of the second coefficient (degrees per second)
60-80	G21.14	A priori standard deviation of the third coefficient (degrees per second or degrees)

To input additional standard deviations, place a second RTASCVAR keyword card with the standard deviations of the fourth and fifth coefficients in the first and second real fields (columns 18 through 38 and 39 through 59). The default values for all a priori standard deviations is infinity (∞) when the parameter is in the solve-for vector and zero when the parameter is in the consider vector.

RTPARAMS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	RTPARAMS--Keyword to set 60-byte Partial Batch Data request parameters
9-11	I3	Timeout interval for 60-Byte Partial Batch Data File polling, in seconds (default = 300 seconds)
12-14	I3	60-Byte Partial Batch Data File polling interval in seconds (default = 5 seconds)
15-17		Blank
18-38	G21.14	Lower bound for staleness interval, in seconds (default = 0 seconds)
39-59	G21.14	Upper bound for staleness interval, in seconds (default = 120 seconds)
60-80		Blank

NOTE: The staleness time for a batch of data is defined as the TCOPS-receipt time of the first frame in the batch minus the time tag of the first frame in the batch. A batch of partial batch data will be made available for GTDS processing if its staleness time falls within the interval defined by the bounds on this card.

RTPARAMS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	RTSATID--Keyword to set 7-digit international designators for all satellites for which 60-byte partial batch data is requested.
9-11	I3	Number of satellite ID numbers to be input on the next card
12-80		Blank

An input card with a format of 10 (I7, 1X) containing all the 7-digit satellite IDs for which partial batch data is to be requested must follow immediately after the RTSATID keyword card, as shown in the following example:

```
Column 2    11
RTSATID      3
1234567b7654321b7777777
```

Partial batch data for up to 10 satellites may be requested. If no RTSATID card is included, partial batch data for the target satellite and all TDRS relay satellites included in the run will be requested.

RSYS****

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	RSYS****--Keyword to set acronym of tracking system for which 60-Byte Partial Batch Data is requested. The asterisks represent the system acronym (see Note). Default = all systems currently receiving data. Only one RSYS**** card may be included in a DC or EARLYORB mode
9-80		Blank

NOTE: Valid tracking system acronyms are TDRS, CBAN, SRE.

RSTA****

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	RSTA****--keyword to set acronym of tracking station for which partial batch data is requested. The asterisks represent the station acronym (see Appendix C for a list of acceptable station acronyms). Default = all stations currently receiving data. Only one RSTA**** card may be included in the DC or EARLYORB mode.
9-80		Blank

SAMPLRTE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs:
- Detailed format:

Columns	Format	Description
1-8	A8	SAMPLRTE--keyword to set edit acceptance criteria by every N second (see Note).
9-17		Blank
18-38	G21.14	Sample rate in second
38-80		Blank

NOTE: The keyword card is considered a continuation of Abbb**** card. The field 18 through 38 is used to replace field 12 through 14 in Abbb***. To use this card the prerequisite condition is set field 12 through 14 i Abbb**** to negative (-xy).

SATGROUP

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SATGROUP--keyword to activate the satellite grouping capability of the GTDS data management subsection
9-11	I3	Number of satellite ID numbers to be input on the next card
12-80		Blank

An input card with a format of 10(I7, 1x) containing all the seven-digit satellite IDs to be grouped with the satellite ID on the CONTROL card must follow immediately after the SATGROUP keyword card, as shown in the following example:

```
Column 1          11
       SATGROUP   3
       1234567b7654321b7777777
```

The maximum of 10 satellites may be grouped. The only valid input data source for satellite grouping is the 60-byte data base.

SAVEW

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SAVE--keyword to specify the option to save observations working file from this run
9-11	I3	Save indicator: = 1, write observations working file to tape, (unit 46) in GTDS format = 2, do not save observations working file (default)
12-80		Blank

SCAREA

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	SCAREA--keyword to set spacecraft cross-sectional area by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Spacecraft cross-sectional area (km^2) for section I
39-59	G21.14	Spacecraft cross-sectional area (km^2) for section J
60-80	G21.14	Spacecraft cross-sectional area (km^2) for section K

The spacecraft cross-sectional area for section one is normally set by using the SCPARAM keyword card. Specifying section one on this card will cause this initial cross-sectional area to be overridden. A maximum of 10 flight sections is allowed.

SCPARAM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	SCPARAM--keyword to set spacecraft parameters
9-11	I3	Use mass/thrust tables: = 0, no (default) = 1, yes
12-14	I3	Number of segments
15-17	I3	Blank
18-38	G21.14	Average cross-sectional area (km^2) used for solar radiation computation
39-59	G21.14	Spacecraft mass (kg)
60-80	G21.14	Diameter of the spacecraft body (km; default = spherical configuration computed from cross-sectional area; used for dynamics only)

SECTRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	SECTRPT--keyword to specify a report of the Flight Sectioning Models File
9-11	I3	Summary report: = 0, summary report will not be printed (default) = 1, summary report will be printed
12-14	I3	Full report: = 0, full report will not be printed (default) = 1, full report will be printed
15-17	I3	Model to be reported (required if column 14 = 1): (for flight sectioning model numbers see Appendix D, Item D): = 0, all models > 0, model number
18-80		Blank

This card may be included only once per PFROPT subdeck.

SELOUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SELOUT--keyword to generate the Statistical Output Report
9-11	I3	Indicator for when to generate the SOR: = 0, at first and last DC Program iterations (default) = 1, at first DC Program iteration only = 2, at last DC Program iteration only
12-14	I3	Indicator for computing noise batch calibration statistics and noise estimation: = 0, no calibration statistics or noise estimation = 1, generate batch calibration statistics, and noise estimation (Noise estimation is done only when batch calibration statistics are generated.) (See Table 4-7) = I, use the default minimum percentage as the minimum percentage of points (pth order differences) required, after internal editing, for noise estimation (Default = 75 percent) = II, (2 ≤ II ≤ 99)*: minimum percentage of points (pth order differences) required, after internal editing, for noise estimation

*Percentage is based on points actually used for noise estimation, relative to the number of observations initially considered for determination of noise and calibration statistics for a "batch - SOR category" set.

Table 4-7. SOR Request (SELOUT Keyword)

SOR Generation Time (First Integer Field)	Batch Calibration Statistics (Second Integer Field)	Result
0: SOR generated at first and last iteration	0: No Calibration Statistics	Neither SOR contains calibration statistics
	≥ 1	First SOR: No calibration statistics Second SOR: Calibration Statistics
1: SOR generated for first iteration	0: No Calibration Statistics	SOR does not contain calibration statistics
	≥ 1	SOR contains calibration statistics
2: SOR generated at last iteration	0: No Calibration Statistics	SOR does not contain calibration statistics
	≥ 1	SOR contains calibration statistics

Columns	Format	Description
15-17	I3	Packed indicators MN for generating SOR data subset and "punched" output (MN right adjusted) M: indicator for generating SOR data subset: Output (1 = Yes, 0 = No) N: indicator for generating punch output = 0, no (default) = 1, calibration statistics only = 2, final vector only (see Note 2) = 3, calibration statistics and final vector (see Note 2) = 4, calibration statistics with TDRS one-way Doppler data and associated User Receive Center Frequency information excluded = 5, calibration statistics with TDRS on-way Doppler data and associated URC frequency information included (see Note 3) = 6, TDRS one-way Doppler data and associated URC frequency information only (see Note 3) = 7, to generate Tracking Data Validation Extract File (FT62) after a DC iteration (see columns 9 through 11)
18-38	G21.14	Maximum time gap between two consecutive observations in a batch (default = 300. seconds)
39-59	G21.14	Maximum time interval of a batch (default = 1.D+6 seconds)
60-80	G21.14	Maximum number of observations in a batch (default and the largest input value allowed is 500.)

NOTES: 1. True punched output is no longer available from the FDF R1 and R2 NAS computers. The "punched" output referred to in this keyword card description may be printed by overriding the SYSOUT parameter with class A in the JCL for FT 07.

Alternatively, this output may be routed to a disk file by providing an appropriate DSN and space parameter.

2. For magnetic tape output of the SOR Extract, the following JCL card override is needed (when column 16 is 1):
   //GO.FT64F001 DD DSN=ORBIT.SOROUT

3. Final vectors are punched only for those satellites that have associated dynamic parameters solved for. The final vectors are punched in the format of the ELEMENT1, ELEMENT2, EPOCH, SSELEM1, SSELEM2, SSEPOCH, TDRELEM1, TDRELEM2, and TDREPOCH keyword cards. When no epoch advance is applied in the DC Program, zero is punched in the third real field of the EPOCH, SSEPOCH, or TDREPOCH card. When an epoch advance is applied in the DC Program, the output advanced epoch is incremented by a time equal to the difference between the input epoch and the original advanced epoch and is punched in the third real field.

4. The TDRS one-way Doppler data and associated User Receive Center frequency information, when requested, are directed to a file separate from the remaining calibration statistics punched output. An override card for FT 47, specifying a DSN and a space parameter, must be provided to save this output. See Note 1.

SLPBODY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT, ANALYSIS, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	SLPBODY--keyword to set central and noncentral bodies for generating the Solar/Lunar/Planetary ephemeris working file
9-11	I3	Central body index (default = 1, Earth)
12-14	I3	Fast noncentral body index (default = 2, Moon)
15-17	I3	First slow noncentral body index (default = 3, Sun)
18-38	G21.14	Second slow noncentral body index (in real format; default = 0)
39-59	G21.14	Third slow noncentral body index (in real format; default = 0)
60-80	G21.14	Fourth slow noncentral body index (in real format; default = 0)

A second SLPBODY card may be used to specify three more slow noncentral body indexes in the three integer fields. The second SLPBODY keyword card must immediately follow the first SLPBODY keyword card that specifies the central body index in the first integer field.

The body indexes are

1 = Earth	4 = Mars	7 = Uranus	10 = Mercury
2 = Moon	5 = Jupiter	8 = Neptune	11 = Venus
3 = Sun	6 = Saturn	9 = Pluto	

SLPCOORD

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT, ANALYSIS, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	SLPCOORD--keyword to specify the SLP ephemeris coordinate system reference
9-11	I3	Coordinate system reference: = 1, mean equator and equinox of 1950.0 (default) = 2, true-of-date
12-80		Blank

SLPDEG

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT, ANALYSIS, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	SLPDEG--keyword to set degree of curve-fit for bodies (specified by keyword SLPBODY) and rotation matrices (The default for the fast noncentral body is the Moon, and the default for the first slow noncentral body is the Sun. Keyword SLPBODY must be used to change these default values when desired.)
9-11	I3	Curve-fit degree for matrix elements (default = 8; maximum = 9)
12-14	I3	Fast noncentral body position curve-fit degree (default = 4; maximum = 19)
15-17	I3	Fast noncentral body velocity curve-fit degree (default =8; maximum = 12)
18-38	G21.14	Slow noncentral bodies' positions curve-fit degree (default = 4; maximum = 12)
39-80		Blank

SLPELRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM,
- Detailed format:

Columns	Format	Description
1-8	A8	SLPELRPT--keyword to obtain report of Solar/Lunar/Planetary Ephemeris File by body
9-11	I3	Reporting time option: = 0, times specified in UTC = 1, times specified in Ephemeris Time (ET)
12-14	I3	Reporting selection option: = 0, report for Sun and Moon only = 1, report all bodies
15-17		Blank
18-38	G21.14	Report start time (yymmddhhmmss.ssss)
39-59	G21.14	Report end time (yymmddhhmmss.ssss)
60-80	G21.14	Time interval (days)

This card may be included only once per PFROPT subdeck.

NOTE: Although included in the PFROPT subdeck, the SLP Elements Report option accesses the SLP working file rather than the SLP permanent file. For this reason, the option is not available from the FILERPT Program. Furthermore, when running a stacked deck, the RESTORE option must be used on the CONTROL card of each control section following the first, in order to ensure that the correct working file will be referenced.

SLPFILE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT, ANALYSIS, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	SLPFILE--keyword to indicate the source of SLP data to be used in creating the SLP working file (see Note)
9-11	I3	SLP working file option: = 1, use permanent file = 2, create direct access working file from SLP tape = 3, not in use = 4, create SLP tape from JPL tape = 5, create direct access working file from JPL tape = 6, not in use = 7, not in use = 8, use previously created working file
12-14	I3	Number of days per curve-fit (default = 20)
15-17	I3	Number of curve-fits to be computed (default = 11)
18-38	G21.14	Year, month, day (yymmdd.0) of the first day of SLP ephemeris
39-59	G21.14	Type of input JPL tape = 0, DE-96 (default) = 1, DE-19
60-80		Blank

NOTE: The JCL in the GTDS procedure is set up for the DE96 JPL tape. For the DE19 tape, the DCB parameters on FT34 must be overridden as follows:

DCB = (LRECL=2304,BLKSIZE=8308)

See Section 5 for additional information.

SLPRPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: FILERPT, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	SLPRPT--keyword to specify a report of the SLP Ephemeris File by matrix order
9-11	I3	Type of report: = 0, summary report = 1, full report without transformation matrices to order 6 = 2, full report without transformation matrices to higher order = 3, full report with transformation matrices to order 6 = 4, full report with transformation matrices to higher order = 5, full report on complete file
12-17		Blank
18-38	G21.14	Start time of report (yymmdd.)
39-59	G21.14	End time of report (yymmdd.)
60-80		Blank

Start and end times for the report are not needed when the full report on the complete file, or the summary report, is requested.

This card may be included only once per PFROPT subdeck.

Report is produced only for SLP data referenced to 1950.0 coordinates.

SNM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, EARLYORB, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	SNM--keyword to set the $S_{n,m}$ harmonic coefficients options and values
9-11	I3	Harmonic options: = 1, compute partial derivatives of state with respect to specified harmonic using default value = 2, instead of the default value use the value in columns 18-38 and compute partial derivatives = 3, instead of the default value use the value in columns 18-38
12-14	I3	N coefficient (maximum of 21)
15-17	I3	M coefficient (maximum of 21)
18-38	G21.14	Value of $S_{n,m}$
39-59	G21.14	Standard deviation of $S_{n,m}$
60-80	G21.14	Central body number of input harmonic coefficients: = 1.0, Earth = 2.0, Moon

In a DC Program run, the option to compute partial derivatives indicates that the harmonic coefficients will be solved for using either the default value or the input value (in columns 18 through 38) as the a priori harmonic coefficient and the a priori standard deviation in columns 39 through 59.

Individual $S_{n,m}$ coefficients are defined using this keyword card. To change an entire harmonic field, see the HARMONIC keyword card. To compute a partial derivative

with respect to $C_{n,m}$ or $S_{n,m}$, it must be used in the force model (see Reference 2, Section 4.3, for definitions of $C_{n,m}$ and $S_{n,m}$).

SOLRAD

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	SOLRAD--keyword to set the force model solar radiation switch for each section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Solar radiation switch for section I
39-59	G21.14	Solar radiation switch for section J
60-80	G21.14	Solar radiation switch for section K

A value of 1.0 in the real fields (G21.14) will include solar radiation effects in the force model for the specified section(s), and a value of 2.0 will cause the solar radiation effects to be ignored in the force model. The default value for these options is 2.0. Note that a spacecraft area and mass must be specified on the SCPARAM card when using this option.

When the solar radiation effects are included in an EPHEM Program run, a message indicating whether the vehicle is in sunlight or shadow is printed in each Satellite Ephemeris Report.

SOLRDPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	SOLRDPAR--keyword to set the solar radiation options and parameter
9-11	I3	Solar radiation outputs: = 0, do not compute partial derivatives = 1, compute partial derivatives of state with respect to solar radiation parameter C_r = 2, instead of the default value, use the value in columns 18 through 38 and compute solar partial derivatives = 3, instead of default, use the value in columns 18 through 38
12-17		Blank
18-38	G21.14	Solar radiation coefficient (C_r)
39-59		Blank
60-80	G21.14	Standard deviation of solar radiation

In a DC Program run, the option to compute partial derivatives indicates that the solar radiation coefficient (C_r) will be solved for using either the default value or the input value (in columns 18 through 38) as the a priori solar radiation coefficient and the a priori standard deviation in columns 60 through 80.

To compute partial derivatives of the state with respect to the solar radiation pressure parameter, C_r, solar radiation must be used in the force model (see the SOLRAD keyword card).

SORINPUT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SORINPUT--keyword to set Statistical Output Report editing parameter for an SOR category (maximum of 10 cards allowed)
9-11	I3	Format type of observations: = 0, 60-byte = 1, 100-byte
12-14		Blank
15-17	I3	Number of SOR editing loops (if 0 or blank is input, the number of SOR editing loops is defaulted to six loops; if -1 is input, no SOR editing will be performed)
18-38	G21.14	SOR editing sigma multiplier value (default = 3.0)
39-59	G21.14	Maximum O-C value (units are meters for range, milliseconds for range rate, hertz for ATSR and TDRS relay Doppler, degrees of arc for angles, and counts for Minitrack direction cosines)
60-80	G21.14	For 60-byte observations, input a combination of DDTTMMRR. for the SOR category. DD = observation type indicator (see Appendix A, Table A-2) with the following exceptions: = 11, XY parabolic X85 = 12, XY parabolic Y85 = 17, SRE X14 = 18, SRE Y14 = 42, ATSR sidetone range

Columns	Format	Description
60-80 (Cont'd)		TT = tracker type number (see Table 4-1) with the following exceptions: = 4, SRE X14, Y14 = 5, SRE X30, Y30, and USB85 range and range rate = 6, SRE X85
		MM = equipment mode indicator (applies only to Minitrack data and ATSR relay data): = 0, Minitrack equatorial mode = 1, Minitrack polar mode = 2, satellite PLL mode = 3, satellite crystal mode = 4, ground crystal mode = 5, ground PLL mode
		or
		MM = frequency band indicator (applies to TDRS one-way or two-way Doppler data from user spacecraft but not to user ground transponders): = 1, S-Band = 2, K-Band
		MM = multiple access indicator (applies to TDRS beam angles): = 1, single access = 2, multiple access
		RR = data rate indicator for ATSR range rate data (sidetone, coherent, and ground relay mode): = 0, for data rate $\neq$ 6 per minute = 4, for data rate = 6 per minute
		For other ATSR data types: = 0, for all data rates
		For TDRSS Doppler data (two-way, hybrid, differenced one-way from user ground transponder but not user spacecraft): = 1, for data rate $\geq$ 40 per minute = 2, for 40 per minute > data rate > 9 per minute = 3, for data rate $\leq$ 9 per minute

Columns	Format	Description
60-80 (Cont'd)		For other TDRSS data types: = 0, for all data rates
		For 100-byte observations, input weight index number of the SOR category (see Appendix A, Table A-2)

SORVALID

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SORVALID--keyword to override the data validity check for up to three SOR categories (based on data quality flags) in the DC Programs and SOR
9-11	I3	Override the data validity check for SOR category I: = 1, yes = 2, no (default)
12-14	I3	Override the data validity check for SOR category J: = 1, yes = 2, no (default)
15-17	I3	Override the data validity check for SOR category K: = 1, yes = 2, no (default)
18-38	G21.14	SOR category I type indicator (see Appendix A, Table A-2) with the following exceptions: = 11, XY parabolic X85 = 12, XY parabolic Y85 = 17, SRE X14 = 18, SRE Y14 = 42, ATSR sidetone range TT = tracking system number (see Table 4-1) with the following exceptions: = 4, SRE X14, Y14 = 5, SRE X30, Y30, and USB85 range and range rate = 6, SRE X85

SORVALID

Columns	Format	Description
18-38 (Cont'd)		= 99, override data validity check for all SOR categories of the input observations MM = equipment mode indicator (applies only to Minitrack data and ATSR relay data): = 0, Minitrack equatorial mode = 1, Minitrack polar mode = 2, satellite PLL mode = 3, satellite crystal mode = 4, ground crystal mode = 5, ground PLL mode or MM = frequency band indicator (applies to TDRS one-way or two-way Doppler data from user spacecraft but not to user ground transponders): = 1, S-Band = 2, S-Band MM = multiple-access indicator (applies to TDRS beam angles): = 1, single-access = 2, multiple-access RR = data rate indicator for ATSR range rate data in sidetone, coherent, and ground relay mode: = 4, 6 observations per minute = 0, all others Also applies to TDRS two-way, hybrid or differenced one-way Doppler data from ground transponder but not to user spacecraft: = 1, data rate is greater than or equal to 40 observations perminute = 2, data rate is between 9 and 40 observations per minute = 3, data rate is less than or equal to 9 observations per minute

SPHERE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	SPHERE--keyword to set the sphere of influence for the planetary bodies
9-11	I3	Index of body I
12-14	I3	Index of body J
15-17	I3	Index of body K
18-38	G21.14	Radius of sphere of influence (kilometers) for body I
39-59	G21.14	Radius of sphere of influence (kilometers) for body J
60-80	G21.14	Radius of sphere of influence (kilometers) for body K

See Appendix B for body indexes.

SPHINF

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	SPHINF--keyword to set the sectioning indicator for crossing when the sphere of influence of the central body is crossed
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Sphere-of-influence indicator for section I
39-59	G21.14	Sphere-of-influence indicator for section J
60-80	G21.14	Sphere-of-influence indicator for section K

A value of 1.0 will set the switch to change section at sphere of influence of central body, and a value of 2.0 will turn the switch off. The default value is 1.0.

SSCPVAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SSCOVAR--keyword to set upper triangle of the a priori state covariance matrix for an ATSR relay satellite
9-11	I3	Packed row-and-column integer for element I (see Note 1)
12-14	I3	Packed row-and-column integer for element J (see Note 1)
15-17	I3	Packed row-and-column integer for element K (see Note 1)
18-38	G21.14	Matrix element I (see Note 2)
39-59	G21.14	Matrix element J (see Note 2)
60-80	G21.14	Matrix element L (see Note 2)

NOTES:
1. The packed row-and-column integer is given by 10 * row number + column number.
2. At present only the diagonal elements are used in GTDS for the a priori covariance matrix because of space limitations.

SSELEM1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description	
1-8	A8	SSELEM1--keyword to set the first three components of the initial state vector of the ATS relay satellite and to identify the coordinate system and solve-for status of the initial state	
9-11	I3	= 0, do not solve for ATS relay satellite state (default) ≠ 0, solve for ATS relay satellite state	
12-14	I3	Input coordinate system orientation: = 1, mean Earth equator and equinox of 1950.0 = 2, true of reference, Earth equator, and equinox = 3, true of epoch, Earth equator, and equinox = 4, mean ecliptic and equinox of 1950.0 = 5, true of epoch, ecliptic, and equinox	
15-17	I3	Input coordinate system type: = 1, Cartesian = 2, Keplerian	
		Cartesian	Keplerian
18-38	G21.14	X position	Semimajor axis (a)
39-59	G21.14	Y position	Eccentricity (e)
60-80	G21.14	Z position	Inclination (i)

Columns 18 through 80 have no default values.

SSELEM2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description	
1-8	A8	SSELEM2--keyword to set the second three components of the initial state of the ATS relay satellite (Units are kilometers, kilometers per second, and degrees.)	
9-17	3I3	Blank	
		Cartesian	Keplerian
18-38	G21.14	X velocity	Longitude of ascending node (Ω)
39-59	G21.14	Y velocity	Argument of perigee (ω)
60-80	G21.14	Z velocity	Mean anomaly (M)

This keyword has no default values.

SSEPOCH

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SSEPOCH--keyword to set the epoch for the ATS relay satellite
9-17		Blank
18-38	G21.14	Year, month, day of epoch (yymmdd.0) (see Note)
39-59	G21.14	Hours, minutes, seconds of epoch (hhmmss.ssss) (see Note)
60-80		Blank

NOTE: When blank, this value will default to the value on the EPOCH keyword card.

SSOPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	SSOPT--keyword to set the orbit generator type for the ATS relay satellite orbit and to set the spacecraft parameters for the ATS relay satellite
9-11	I3	Orbit generator type (defaults to the orbit generator type on the ORBTYPE keyword): = 1, time-regularized Cowell = 2, Cowell = 6, pregenerated ORBIT File
12-14	I3	Atmospheric editing switch (editing implies rejecting observations due to the relative position of the satellites and the atmosphere): = 0, edit (default ≠ 0, do not edit
15-17		Blank
18-38	G21.14	Average cross-sectional area used for solar radiation computation (kilometers^2)
39-59	G21.14	Spacecraft mass (kilograms)
60-80	G21.14	Diameter of the spacecraft body (kilometers)

SSTSIM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	SSTSIM--keyword to set the necessary parameters used in simulation of ATS SST data
9-11	I3	FRN of the relay satellite ORBIT File: Unit 19 = ORBIT File with partial derivatives (direct access) Unit 20 = ORBIT File without partial derivatives (direct access) Unit 21 = ORBIT File with partial derivatives (sequential) Unit 22 = ORBIT File without partial derivatives (sequential)
12-14	I3	Mode of data to be simulated: = 2, phase-locked loop = 3, crystal
15-17	I3	Frequency indicator: = 1, 5950 and 3750 megahertz = 2, 5960 and 3950 megahertz = 3, 5950 and 4150 megahertz = 4, 6150 and 3750 megahertz = 5, 6150 and 3950 megahertz = 6, 6150 and 4150 megahertz = 7, 6350 and 3750 megahertz = 8, 6350 and 3950 megahertz = 9, 6350 and 4150 megahertz
18-38	G21.14	= 0, nondestruct data ≠ 0, destruct data
39-59	G21.14	Delta F: 12.15 = NIMBUS-F 5.8875 = Geodynamics Experimental Ocean Satellite (GOES) -2.4 = Apollo-Soyuz Test Project (ASTP)
60-80		Blank

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	STATEPAR--keyword to set the state vector partial derivatives switch to compute state partial derivatives in an EPHEM Program run, or to indicate state solve-for parameters in a DC Program run
9-11	I3	State solve-for parameter component type: = 1, Cartesian unknowns (default) = 2, Keplerian unknowns = 3, spherical unknowns = 4, DODS unknowns (default for Brouwer and Brouwer-Lyddane)
12-14	I3	Mapping of initial state covariance matrix (for orbit generator only): = 1, yes = 2, no (default)
15-17	I3	Angle Phi for DODS unknowns type: = 1, argument of latitude = 2, argument of perigee at epoch (default) = 3, true anomaly + argument of perigee at epoch = 4, true anomaly + argument of perigee at time t
18-39	G21.14	Value of argument of latitude if value in columns 15 through 17 is 1.0
39-59	G21.14	Method of computing state partial derivatives switch: = 1.0, analytic state partial derivatives ≠ 1.0, numerical state partial derivatives
60-80		Blank

STATEPAR
(OGOPT)

This card is used in conjunction with the STATETAB keyword card. Selection of particular state components to be included in the solve-for state can be made with the STATETAB keyword card.

In the absence of the STATETAB keyword card

1. No state partial derivatives will be computed for an EPHEM program run

2. Six state partial derivatives will be solved for in a DC Program run. The partial derivatives will be of the Cartesian type unless overridden by the STATEPAR card. The STATETAB card can also be used to turn off state partial derivatives computation for a DC Program run.

STATETAB

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	STATETAB--keyword to set the required state parameters components for computation of partial derivatives and/or solve-for state parameters
9-11	I3	Parameter type code (unknown) I
12-14	I3	Parameter type code (unknown) J
15-17	I3	Parameter type code (unknown) K
18-38	G21.14	Parameter type code (unknown) L in real format
39-59	G21.14	Parameter type code (unknown) M in real format
60-80	G21.14	Parameter type code (unknown) N in real format

See Appendix A, Table A-1, for the appropriate parameter types. The default values are 1 through 6.

In a DC Program run, the default will be to compute all six partial derivative components. To reduce or change the number of unknowns, the STATETAB card is required. If no state partial derivatives are desired, this card must be present with the first integer field (columns 9 through 11) blank.

STEPSIZE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	STEPSIZE--keyword to set the integration stepsize by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Stepsize (seconds) for section I
39-59	G21.14	Stepsize (seconds) for section J
60-80	G21.14	Stepsize (seconds) for section K

The stepsize for section one is normally set using the mandatory ORBTYPE keyword card. Specifying section one on this card will cause this initial stepsize to be overridden. A maximum of 10 flight sections is allowed.

TDRBATCH

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRBATCH--keyword to set the batching criterion override to TDRSS Statistical Output Report
9-11	I3	Telemetry bit rate override option: = 0, user telemetry bit rate is keyed on to form batches (default) = 1, user telemetry bit rate is not keyed on to form batches
12-14	I3	Multiple access (MA) RF Beam Forming Equipment ID override option: = 0, MA Link ID is keyed on to form batches (default) = 1, MA Link ID is not keyed on to form batches
15-17	I3	Return-link tracking frequency override option: = 0, return-link tracking frequency is keyed on to form batches (default) = 1, return-link tracking frequency is not keyed on to form batches
18-38	G21.14	VIC override option: = 0, VIC is keyed on to form batches (default) = 1, VIC is not keyed on to form batches
39-80		Blank

TDRCOV1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRCOV1--keyword to set the upper triangle of the a priori state covariance matrix for the TDRS placed in position 1 (columns 9 through 11) on the TDRID card (see the TDRID card for a description)
9-11	I3	Packed row-and-column integer for element I (see Note 1)
12-14	I3	Packed row-and-column integer for element J (see Note 1)
15-17	I3	Packed row-and-column integer for element K (see Note 1)
18-38	G21.14	Matrix element J (see Note 2)
60-80	G21.14	Matrix element K (see Note 2)

NOTES: 1. The packed row-and-column integer is given by 10 * row number + column.

2. Currently, only the DIAGONAL elements are actually used to set the a priori covariance matrix.

TDRCOV2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRCOV2--keyword to set the upper triangle of the a priori state covariance matrix for the TDRS placed in position 2 (columns 12 through 14) on the TDRID card (see the TDRID card for a description)
9-11	I3	Packed row-and-column integer for element I (see Note 1)
12-14	I3	Packed row-and-column integer for element J (see Note 1)
15-17	I3	Packed row-and-column integer for element K (see Note 1)
18-38	G21.14	Matrix element I (see Note 2)
39-59	G21.14	Matrix element J (see Note 2)
60-80	G21.14	Matrix element K (see Note 2)

NOTES:
1. The packed row-and-column integer is given by 10 • row number + column.
2. Currently, only the DIAGONAL elements are actually used to set the a priori covariance matrix.

TDRCOV3

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRCOV3--keyword to set the upper triangle of the a priori state covariance matrix for the TDRS placed in placed in position 3 (columns 15 through 17) on the TDRID card (see the TDRID card for a description)
9-11	I3	Packed row-and-column integer for element I (see Note 1)
12-14	I3	Packed row-and-column integer for element J (see Note 1)
15-17	I3	Packed row-and-column integer for element K (see Note 1)
18-38	G21.14	Matrix element I (see Note 2)
39-59	G21.14	Matrix element J (see Note 2)
60-80	G21.14	Matrix element K (see Note 2)

NOTES:
1. The packed row-and-column integer is given by 10 * row number + column.
2. Currently, only the DIAGONAL elements are actually used to set the a priori covariance matrix.

TDRELEM1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description		
1-8	A8	TDRELEM1--keyword to set the first three components of the initial state vector of a TDRS and the coordinate system		
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID keyword description for further information.)		
12-14	I3	Input reference system orientation: = 1, mean Earth equator and equinox of 1950.0 = 2, true of reference, Earth equator, and equinox = 3, true of epoch, Earth equator, and equinox = 4, mean ecliptic and equinox of 1950.0 = 5, true of epoch, ecliptic, and equinox		
15-17	I3	Input coordinate system type: = 1, Cartesian = 2, Keplerian = 3, Spherical		
		Cartesian	Keplerian	Spherical
18-38	G21.14	X position (kilometers)	Semimajor axis (a) (kilometers)	Right ascension (α) (degrees)
39-59	G21.14	Y position (kilometers)	Eccentricity (e)	Declination (δ) (degrees)
60-80	G21.14	Z position (kilometers)	Inclination (i) (degrees)	Flight path angle (β) (degrees)

TDRELEM2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description		
1-8	A8	TDRELEM2--keyword to set the second three components of the initial state of a Tracking and Data Relay Satellite		
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID keyword description for further information. The TDRS number must NOT be zero or left blank.)		
12-17		Blank		
		Cartesian	Keplerian	Spherical
18-38	G21.14	X velocity (kilometers per second)	Longitude of ascending node (Ω) (degrees)	Azimuth (A) (degrees)
39-59	G21.14	Y velocity (kilometers per second)	Argument of perigee (ω) (degrees)	Radius (r) (kilometers)
60-80	G21.14	Z velocity (kilometers per second)	Mean anomaly (M) (degrees)	Velocity (v) (kilometers per second)

TDREPOCH

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDREPOCH--keyword to set epoch for Tracking and Data Relay Satellite
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID card for further information.)
12-14		Blank
15-17	I3	= 0, epoch supplied in columns 18 through 59 (default) = 1, epoch retrieved from Permanent Elements or 24-Hour Hold Elemen File (A TDRWKELS keyword card must be included in deck if 1 is input. Columns 18 through 59 will be ignored if 1 is input.)
18-38	G21.14	Year, month, day of epoch (yymmdd.0)
39-59	G21.14	Hours, minutes, seconds of epoch (hhmmss.ssss)
60-80	G21.14	Automatic epoch advance option--year, month, day, hour, minute, seconds of epoch about which to perform differential correction (yymmddhhmmss.ssss). The default is no epoch advance desired. This option is valid only for the DC Program.

TDRFILES

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRFILES--keyword to specify the creation of an output ORBIT File at the end of a DC Program, and to set the levels and times of the ORBIT File
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See The TDRID card for further information.) If zero or blank, all the values on this card apply to all TDRS satellites in the run (default = 0).
12-14	I3	Level of output ORBIT File (see Note): = 0, no file is to be generated (default) > 0, level of the direct access file that is to be generated
15-17		Blank
18-38	G21.14	Start time of output ORBIT File (yymmddhhmmss.ssss) (no default)
39-59	G21.14	End time of output ORBIT File (yymmddhhmmss.ssss) (no default)
60-80		Blank

NOTE: A TDRS ORBIT Files are DAIO direct access files that can have multiple levels (default = 1). See the TDRORB card for JCL overrides.

The output ORBIT Files will be generated on the following FORTRAN data sets:

TDRS	FRN
TDRS in position 1	97
TDRS in position 2	98
TDRS in position 3	99

See the TDRID card for definitions of positions 1, 2, and 3.

TDRID

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRID--keyword to set the Tracking and Data Relay Satellite (TDRS) identifier and the seven-digit international designator. (This card must be the first card in the TDROPT subdeck.)
9-11	I3	TDRS number (see Note)
12-14	I3	TDRS number (see Note)
15-17	I3	TDRS number (see Note)
18-38	G21.14	Seven-digit international designator for the TDRS identified in columns 9 through 11
39-59	G21.14	Seven-digit international designator for the TDRS identified in columns 12 through 14
60-80	G21.14	Seven-digit international designator for the TDRS identified in columns 15 through 17

NOTE: TDRS number = SIC - 1299, where SIC = Support Identification Code. The TDRS numbers specified in columns 9 through 11, columns 12 through 14, and columns 15 through 17 are stored sequentially at the first, the second, and the third locations, respectively. Any TDRS number can be placed in any of the positions. It is completely arbitrary. The following are two examples of input.

Example 1:

```
Column 1       11  14  17   20            40            60
       TDRID    3   7   1    7990301.      7990701.      7990101
```

TDRS number 3 occupies position 1
TDRS number 7 occupies position 2
TDRS number 1 occupies position 3

Example 2:

```
TDRID   0   0   7   0.0          0.0          7990101
```

TDRS number 7 occupies position 3

The GTDS user must place an entry on the TDRID card for each TDRS relay for which data is to be included in a DC run (MAXIMUM = 3).

The designators of the first, the second, and the third positions will be used internally in GTDS to link satellite-dependent information with a specific relay satellite. Once the positions have been set through the TDRID card, the input on TDRCOV1, TDRCOV2, TDRCOV3, TDRFILES, TDRORB, and TDRWKELS keyword cards and JCL overrides must be consistent with the positions designated.

Therefore, TDRCOV1 is for the TDRS located at position 1 (columns 9 through 11 of TDRID card), TDRCOV2 for the TDRS at position 2 (columns 12 through 14 of TDRID card), and TDRCOV3 for the TDRS at position 3 (columns 15 through 17 of TDRID card).

In cases of using pregenerated TDRS ORBIT Files for DC and/or requesting TDRS ORBIT Files after DC, it is important that the user know in which position a TDRS satellite has been placed, in order to make the correct JCL overrides and data set allocations. (See the TDRFILES and TDRORB keyword card descriptions.)

In the case of TDRS epoch elements to be retrieved from a pregenerated ORBIT File through keyword TDRWKELS, elements for the TDRS assigned to position 1 will be retrieved from FT71, elements for the TDRS at position 2 from FT72, and elements for the TDRS at position 3 from FT73. Proper JCL overrides must be consistent with the positions designated to each TDRS spacecraft.

TDRMODEQ

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRMODEQ--keyword to set the maximum order and degree to be used in evaluating the nonspherical potential of the central body when evaluating the equations of motion of the satellite
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID keyword description for further information.) If the TDRS number is zero or left blank, the values on this card apply to all TDRS satellites in the run (default = 0).
12-14	I3	Maximum order ($0 \leq N \leq 21$; default = 4)
15-17	I3	Maximum degree ($0 \leq N \leq 21$; default = 4)
18-80		Blank

TDRMODVE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRMODVE--keyword to set the maximum order and degree of the nonspherical potential of the central body to be used for the variational equations (the order and degree of the variational equations must be less than or equal to the order and degree of the equations of motion, respectively)
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID keyword description for further information.) If the TDRS number is zero or left blank, the values apply to all TDRS satellites in the run (default = 0).
12-14	I3	Maximum order ($0 \leq N \leq 21$; default = 0)
15-17	I3	Maximum degree ($0 \leq N \leq 21$; default = 2)
18-80		Blank

TDROBSIN

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	TDROBSIN--keyword to set the Tracking and Data Relay Satellite (TDRS) observation data input detail override flags
9-11	I3	Include direct tracking observations for TDRS in position 1 (see the TDRID keyword card description): = 0, yes (default) = 1, no
12-14	I3	Include direct tracking observations for TDRS in position 2 (see the TDRID keyword card description): = 0, yes (default) = 1, no
15-17	I3	Include direct tracking observations for TDRS in position 3 (see the TDRID keyword card description): = 0, yes (default) = 1, no
18-38	G21.14	Include ground transponder relay observations for TDRS in position 1 (see the TDRID keyword card description): = 0.0, yes (default) = 1.0, no
39-59	G21.14	Include ground transponder relay observations for TDRS in position 2 (see the TDRID keyword card description): = 0.0, yes (default) = 1.0, no
60-80	G21.14	Include ground transponder relay observations for TDRS in position 3 (see the TDRID keyword card description): = 0.0, yes (default) = 1.0, no

The TDROBSIN card adds extra Data Management observation selection criteria to the selection criteria specified on the OBSINPUT card under option 2. If direct tracking (USB, SRE) of the relay satellites has been requested on the OBSINPUT card, the direct tracking data for specific relay satellites may be suppressed by using the TDROBSIN card. If relay tracking data have been requested on the OBSINPUT card, the ground transponder relay data for specific relay satellites may be suppressed by using the TDROBSIN card. If direct tracking data for the relays have not been requested on the OBSINPUT card, the three integer fields on the TDROBSIN card will be ignored.

TDROPT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDROPT--keyword to specify processing of the TDROPT subdeck
9-80		Blank

The TDROPT subdeck can contain the following keyword cards:

TDRBATCH	TDRELEM2	TDRMODVE	TDRSTEP
TDRCOV1	TDREPOCH	TDROBSIN	TDRSTPAR
TDRCOV2	TDRFILES	TDRORB	TDRWKELS
TDRCPV3	TDRID	TDRREFLC	TDRXPNDR
TDRELEM1	TDRMODEQ	TDRSCPRM	

The TDROPT subdeck must terminate with the keyword END. If additional subdecks are also used (DMOPT, DCOPT, OGOPT, etc.), they must follow the TDROPT subdeck. Thus for TDRSS runs, TDROPT must be the first subdeck and DMOPT must be the second subdeck in each program input deck.

TDRORB

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRORB--keyword to set the orbit generator type for a Tracking and Data Relay Satellite (TDRS) and to set the spacecraft parameters for the satellite
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID keyword description for further information.) If the TDRS number is zero or left blank, the values on this card apply to all TDRS satellites in the run (default = 0).
12-14	I3	Orbit generator type for ORBIT Files: = 1, time-regularized Cowell = 2, fixed-step Cowell (default) = 6, pregenerated ORBIT File =11, Permanent TDRS Orbit File (PTOF)
15-17	I3	PTOF level number (orbit generator type 11 only) (See Note)
18-38	G21.14	FRN of PTOF (orbit generator type 11 only), must be either 71., 72., or 73.
39-80		Blank

The ORBIT Files used during a TDRSS DC Program run can be either generated prior to the DC Program run (pregenerated ORBIT Files or PTOFs) or created during the DC Program run (scratch ORBIT Files). These ORBIT Files contain the satellite ephemeris information (state vectors and, if desired, partial derivatives) needed to process the TDRSS tracking data.

The TDRS spacecraft parameters previously entered on the TDRORB card are now entered on the TDRSCPRM card.

NOTE: The level number specified in columns 15 through 17 (for orbit generator type II) is optional. If not specified, the level with the latest possible start time is used.

Pregenerated ORBIT Files and PTOFs

A pregenerated ORBIT File or a PTOF may be input for any TDRS that is not being solved for in the DC program. This file will be used for all DC iterations and will not be updated during the DC program.

The JCL overrides needed for the files are as follows:

$$//GO.FT\begin{Bmatrix}71\\72\\73\end{Bmatrix}F001 \text{ DD DSN=name of data set,}$$

$$// \quad DISP=\begin{Bmatrix}(OLD,KEEP)\\SHR\\ \end{Bmatrix} \quad ,$$

A pregenerated ORBIT File (orbit generator type 6) must reside on the first level of the ORBIT File. The FORTRAN Reference Number to be used for such an ORBIT File is determined by the position of each TDRS specified on the TDRID keyword code, as follows:

Position of TDRS as Defined on the TDRID Card	FRN
1	71
2	72
3	73

Any level of a PTOF may be used for the case of orbit generator type 11, with the level number specified in columns 15 through 17. This level number is the first (earliest) level number to be used, and more than one level will be used if necessary. A level number of -1 may be specified in columns 15 through 17, and results in the use of the level with the latest possible start time. The FRN to be used for a PTOF must be specified in columns 18 through 38. This FRN is entirely independent of the position of each TDRS specified on the TDRID card.

Currently, a pregenerated ORBIT File must reside on the first level of the ORBIT File.

Scratch ORBIT Files

Scratch ORBIT Files can be used for the user satellite and all the TDRS satellites. These ORBIT Files are created during the DC Program and are updated before each DC iteration, if needed. A scratch ORBIT File must be created for each satellite that is included in the DC Program run and does not use a pregenerated ORBIT File. If no dynamic solve-for parameters (i.e., state vector, solar radiation pressure, drag, etc.) are being solved for a given satellite, then its ORBIT File should be created without partial derivatives. A file without partial derivatives will be created only once at the beginning of the DC Program run and will be used in all DC Program iterations without being updated. If any solve-for parameters are included in a run for a given satellite, then a scratch ORBIT File must be created containing partial derivatives for that satellite. This file will be updated before each DC Program iteration with the updated state vector, solve-for parameters, and force model parameters. The FORTRAN data set to be used is determined by the position of each TDRS on the TDRID keyword card. The following FORTRAN Reference Numbers will be used for the scratch ORBIT Files:

Satellite	FRN
User satellite	80
TDRS in position 1 as defined on TDRID card	97
TDRS in position 2 as defined on TDRID card	98
TDRS in position 3 as defined on TDRID card	99

PTOFs, pregenerated, and scratch ORBIT Files are direct access data sets created by using the DAIO package. The scratch ORBIT File is always created on the first level (level = 1) of the ORBIT File data set.

FRNs 97, 98, 99 are also used for the end of DC output ORBIT Files (see the TDRFILES card for more information).

NOTE: For any TDRS using pregenerated ORBIT Files, no input elements via TDRELEM1 and TDRELEM2 keyword card are required.

TDRREFLC

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRREFLC--keyword to set the reflectivity options and parameters for the TDRS
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID card for further information.) If the TDRS number is zero or left blank, the values on this card apply to all TDRS satellites in the run (default = 0).
12-14	I3	Mode options: = 0, do not solve for, consider, or apply (default) = 1, apply and solve for = 2, consider (not currently applicable) = 3, apply only
15-17	I3	Parameter options: = 0, no input values for C_r and σ_{C_r} (use default values) = 1, use input values (in columns 18-38) and 61-80)
18-38	G21.14	Reflectivity coefficient (C_r)
39-59		Blank
61-80	G21.14	Standard deviation of reflectivity (σ_{C_r})

NOTE: If elements are extracted from an elements file or PTOF using a TDRWKELS keyword card, solar radiation pressure will be "off" unless a TDRREFLC keyword card is used with the appropriate option in columns 12 through 14. The value of C_R used will be the value retrieved from the elements file or PTOF if columns 15 through 17 contain 0. If a value of C_R is required that differs from that on the file, a TDRREFLC card should be inserted after the TDRWKELS card, with a C_R value in columns 18 through 38.

TDRSCPRM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRSCPRM--keyword to set the TDRS spacecraft parameters
9-11	I3	TDRS number (see Note 1) If it is zero or left blank, all the values on this card apply to all TDRS satellites in the run (default = 0).
12-17		Blank
18-38	G21.14	Average cross-sectional area used for solar radiation computation (kilometers^2) (see Note 2)
39-59	G21.14	Spacecraft mass (kilograms)
60-80	G21.14	Diameter of the spacecraft body (kilometers)

NOTES:
1. TDRS No. = SIC-1299, where SIC = Support Identification Code (see the TDRID keyword description for further information.)
2. The average cross-sectional area is used if the diameter is not specified on columns 60 through 80.

TDRSTEP

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRSTEP--keyword to set the integration stepsize for the TDRSS relay satellites
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID card for further information.) If the TDRS number is zero or left blank, the values on this card apply to all TDRS satellites in the run (default = 0).
12-14		Blank
15-17		Blank
18-38	G21.14	Integration stepsize in seconds for Cowell integration (default = 600 seconds); or number of steps per revolution for time-regularized Cowell integration (default = 100)
39-80		Blank

TDRSTPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRSTPAR--keyword to set the state vector partial derivatives switch to compute state partial derivatives in a DC Program run for a TDRS
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID card for further information.) If the TDRS number is zero or left blank, all the values on this card apply to all TDRS satellites in the run (default = 0)
12-14		Blank
15-17	I3	State solve-for parameter component type: = 1, Cartesian unknowns (default) = 2, Keplerian unknowns = 3, spherical unknowns
18-38	G21.14	Mode option: = 0.0, neither solve-for nor consider (default) = 1.0, solve-for = 2.0, consider (not currently applicable)
39-80		Blank

TDRWKELS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRWKELS--keyword to retrieve elements from elements files for Tracking and Data Relay Satellite spacecraft and to write elements to the files at the end of the DC Program run. This keyword is not applicable to the user satellite. Keyword WORKELS is to be used for the user spacecraft.
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See the TDRID card for further information.) If the TDRS number is zero or blank, all the values on this card apply to all the TDRS satellites in the run, but only when the value in columns 12-14 is 0 or 6.
12-14	I3	Retrieve input elements from the following source: = 0, TDRELEM1 and TDRELEM2 (default) = 1, GTDS Permanent Elements File = 2, 24-Hour Hold Elements File = 6, pregenerated ORBIT File = 7, permanent TDRS ORBIT File (PTOF) (see Note 2)
15-17	I3	For elements source 0, 1, or 2: Write elements at end of DC to elements files: = 0, no output to any elements file (default) = 1, write elements to the GTDS Permanent Elements File = 2, write elements to the GTDS 24-Hour Hold Elements File

Columns	Format	Description
		For elements source 7: FRN of PTOF (must be either 71, 72, or 73)
18-38	G21.14	For elements source 0 or 6: Blank
		For elements source 1 or 2: Element set number for element retrieval
		For element source 7: PTOF level number (see Note 3)
39-59	G21.14	For elements source 0, 1, 2, or 6: Blank
		For elements source 7: Year, month, day of elements to be retrieved (yyymmdd.) (see Note 3)
60-80	G21.14	For elements source 0, 1, or 2, when value in columns 15 through 17 is 1: Permanent Elements File password
		For elements source 7: Hour, minute, seconds of elements to be retrieved (hhmmss.ssss) (see Note 3)

NOTES:

1. If elements are to be retrieved from pregenerated ORBIT File, a corresponding TDREPOCH keyword must be included. The elements associated with the time specified on TDREPOCH will be retrieved from the following FORTRAN data sets:

TDRS	FRN
If the TDRS is in position 1	71
If the TDRS is in position 2	72
If the TDRS is in position 3	73

   See the TDRID card for explanation of positions 1, 2, and 3. Elements are retrieved from level 1 for this case.

2. If elements are to be retrieved from a PTOF, no TDREPOCH keyword card is needed.

3. Either the level number or the time (or both) must be specified. If only the level number is specified, the epoch vector for that level is retrieved. If only the time is specified, the level with the latest possible start time is used for element retrieval, but -1 should be used for the level number.

4. If solar radiation pressure is to be used and the value of C_R is to be retrieved from a PTOF, a TDRREFLC card must be included to turn the solar radiation pressure flag on. See the TDRREFLC card for a full description.

TDRXPNDR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	TDRXPNDR--keyword to set the satellite transponder delay (see Note 1) and to set the switch to solve for that delay in a TDRSS run (see Note 2)
9-11	I3	TDRS number (= SIC - 1299, where SIC = Support Identification Code. See TDRID keyword description for further description.) If the TDRS number is zero, the delay of the user satellite is intended.
12-14	I3	Solve-for flags: = 0, apply transponder delay = 1, apply and solve for transponder delay
15-17		Blank
18-38	G21.14	A priori transponder delay in seconds
39-59	G21.14	A priori transponder delay standard deviation in seconds
60-80		Blank

NOTES:

1. The transponder delay specified by this card is the interval in time between the receipt of the signal by the satellite and the transmission of the signal. If the path of the signal intercepts a satellite more than once, as in the case for a TDRSS two-way measurement, then the transponder delay for that satellite will be applied each time. The transponder delays are applied to the round-trip range values. The sum is divided by 2.0 to yield the range values reported in the DC Program Observation Residuals Report.

2. When applying or solving for ground transponder delay in a TDRSS run, see Station Card 5, /*******5, keyword description.

THRSTCOF

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	I3	THRSTCOF--keyword to set polynomial coefficients (kilometers/second^2) of thrust by flight section. The polynomial is of the following form: $$A_{Thrust} = a_1 + a_2t + a_3t^2 + \ldots + a_8t^7$$
9-11	I3	Flight section I
12-14	I3	= J, subscript for coefficient appearing in columns 18-38 (where J = 1, 4, or 7)
15-17		Blank
18-38	G21.14	Polynomial coefficient corresponding to Jth subscript for section I
39-59	G21.14	Polynomial coefficient corresponding to (J + 1)st subscript for section I
60-80	G21.14	Polynomial coefficient corresponding to (J + 2)nd subscript for section I

A maximum of three THRSTCOF cards may be used for each flight section. Blanks in real fields are entered as zero.

If thrust coefficients are to be solved for in a DC Program run, only one flight section covering the entire observation timespan is allowed.

THRSTPAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	THRSTPAR--keyword to establish the number of polynomial coefficients of thrust to be solved for by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Number of coefficients to be solved for in flight section I
39-59	G21.14	Number of coefficients to be solved for in flight section J
60-80	G21.14	Number of coefficients to be solved for in flight section K

If coefficients of thrust magnitude and thrust axis orientation are to be solved for in a DC Program run, only one flight section covering the entire observation timespan is allowed.

THRSTVAR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	THRSTVAR--keyword to set the variances of thrust acceleration, vehicle right ascension, and vehicle declination
9-17		Blank
18-38	G21.14	Variance of thrust acceleration
39-59	G21.14	Variance of right ascension of thrust vector
60-80	G21.14	Variance of declination of thrust vector

THRUST

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	THRUST--keyword to set the finite thrust option by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Thrust option for section I
39-59	G21.14	Thrust option for section J
60-80	G21.14	Thrust option for section K

A value of 1.0 in the real fields (G21.14) will include thrusting effects in the force model for the specified section(s), and a value of 2.0 will cause thrusting effects to be ignored in the force model. The default value for this option is 2.0. The finite burn model must be supplied on the THRSTCOF keyword card when the thrust option is requested. Additionally, the default values for spacecraft attitude (right ascension and declination) are both zero. These may be modified by the ATTANG1 and ATTANG2 cards, respectively.

If coefficients of thrust magnitude and thrust axis orientation are to be solved for a in a DC Program run, only one flight section covering the entire observation timespan is allowed.

THSHORT1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: THMODEL (see Notes 1 and 2)
- Detailed format:

Columns	Format	Description
1-8	A8	THSHORT1--first keyword to initiate computation of thrust parameters for a short burn
9-11	I3	FSF output option 0 = result from iteration of best estimate will be output to FSF (default) 1 = result from last iteration will be output to FSF 2 = no result will be output to FSF
12-14	I3	Maximum number of iterations (default = 8)
15-17	I3	Matrix freeze number to indicate number of times the initial coefficient matrix of numerical partials is to be used (default = unlimited)
18-38	G21.14	Maximum tolerance in X position (km) (default = 0.0176)
39-59	G21.14	Maximum tolerance in Y position (km) (default = 0.0176)
60-80	G21.14	Maximum tolerance in Z position (km) (default = 0.0176)

NOTES: 1. THMODEL is a standalone program; stacked ephem may not be used with it.

2. When running THMODEL Program, all and only the following keyword cards must be used in the OGOPT card deck: THSHORT1, THSHORT2, THSHORT3, THSHORT4, and THSHORT5.

THSHORT2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: THMODEL
- Detailed format:

Columns	Format	Description
1-8	A8	THSHORT2--second keyword to initiate computation of thrust parameters for a short burn
9-11	I3	Option to output result at each iteration: 0 = No 1 = Yes (default)
12-14	I3	Matrix option: 0 = thrust, pitch, yaw 1 = thrust, pitch, yaw, thrust rate, pitch rate, and yaw rate (default)
15-17	I3	Blank
18-38	G21.14	Maximum tolerance in X velocity (km/sec) (default = 0.000176)
39-59	G21.14	Maximum tolerance in Y velocity (km/sec) (default = 0.000176)

See notes for keyword card THSHORT1.

THSHORT3

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: THMODEL
- Detailed format:

Columns	Format	Description
1-8	A8	THSHORT3--third keyword to initiate computation of thrust parameters for a short burn
9-11	I3	Blank
12-14	I3	Blank
15-17	I3	Blank
18-38	G21.14	Change in yaw angle (degree) (default = 1)
39-59	G21.14	Change in yaw angle (degree) (default = 1)
60-80	G21.14	Change in thrust acceleration (km/sec^2) (default = 0.001)

NOTES: 1. Changes in pitch, yaw, thrust acceleration, pitch rate, yaw rate, and thrust acceleration rate as specified in THSHORT3 and THSHORT4 keyword cards are used for the computation of the correction matrix (see Reference 15, Section 3.4.1). Unless the user wants to input different values for a wanted results, default values can be used in most cases.

2. See notes in keyword card THSHORT1.

THSHORT4

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: THMODEL
- Detailed format:

Columns	Format	Description
1-8	A8	THSHORT4--fourth keyword to initiate computation of thrust parameters for a short burn
9-11	I3	Blank
12-14	I3	Blank
15-17	I3	Blank
18-38	G21.14	Change in pitch rate (degree/sec) (default = 0.01)
39-59	G21.14	Change in yaw rate (degree/sec) (default = 0.01)
60-80	G21.14	Change in thrust acceleration rate (km/sec^3) (default = 0.000002)

See notes for keyword cards THSHORT1 and THSHORT3.

THSHORT5

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: THMODEL
- Detailed format:

Columns	Format	Description
1-8	A8	THSHORT5--fifth keyword to initiate computation of thrust parameters for a short burn
9-11	I3	Maneuver number (from 1 to 5)
12-14	I3	Record number (element set number) for ignition state vector
15-17	I3	Record number (element set number) for burnout state vector
18-38	G21.14	Time of ignition (yymmddhhmmss.ssss)
39-59	G21.14	Time of burnout (yymmddhhmmss.ssss)
60-80	G21.14	Stepsize for propagator (sec) (default = tenth of burn interval)

See notes for keyword card THSHORT1.

THSOFNO

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	THSOFNO--keyword to set thrust solve-for flags
9-11	I3	Number between 1 and 20 that indicates which thrust segment is to be solved for*
12-14	I3	
15-17	I3	
18-38	G21.14	Indicator: 1.0 = solve for thrust
39-59	G21.14	
60-80	G21.14	

NOTE: Use of this card requires the THRSTPAR card.

THTAB1

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	THTAB1--first table definition card
9-11	I3	Manuever segment number
12-14	I3	Linear interpolation number: = 1, segment has 3 or more entries = 2, segment has 2 entries
15-17	I3	Blank
18-38	G21.14	Start time of the given manuever segment in seconds from epoch
39-59	G21.14	Stop time of the given manuever segment in seconds from epoch
60-80	G21.14	User-specified time stepsize for the given maneuver segment in seconds from epoch (NOTE: If the stepsize selected by the user is smaller than the GMAN stepsize, the GMAN will be used)

THTAB2

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	THTAB2--second table definition card
9-11	I3	Manuever segment number
12-14	I3	Blank
15-17	I3	Blank
18-38	G21.14	Start time for this segment in seconds from the beginning of the burn in the GMAN working file
39-59	G21.14	Mass calibration factor
60-80	G21.14	Thrust calibration factor

TIMES

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	TIMES--keyword to set the run reference date and the Ephemeris Generation Program print start time
9-17		Blank
18-38	G21.14	Reference date (yymmdd.0) for true of reference system
39-59	G21.14	Start time of print arc (yymmdd.0)
60-80	G21.14	Start time of print arc (hhmmss.ssss)

The default reference date will be the epoch year, month, and day if the first real field (columns 18 through 38) is blank.

Epoch will be the default start time of the print arc if the second real field (columns 39 through 59) is blank.

The reference date for the true-of-reference system should be input only if the initial state vector (on ELEMENT1 and ELEMENT2 cards) is in the true-of-reference system (I1 = 2 on ELEMENT1 card) and the EPOCH (i.e., time tag) of the initial state vector is different from the reference date.

TIMREG

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	TIMREG--keyword to set the section-dependent time regularization constant of the satellite radius
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Time regularization exponent for section I
39-59	G21.14	Time regularization exponent for section J
60-80	G21.14	Time regularization exponent for section K

The time regularization exponent (n) defines the type of independent variable (s) by the relation

$$\frac{dt}{ds} = \frac{\sqrt{\mu}}{r^n} \qquad 1 \leq n \leq 2$$

where n = 1.0 indicates that the independent variable is the eccentric anomaly and n = 2.0 for true anomaly. The default value for n is 1.5.

TIMREGDV

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	TIMREGDV--keyword to set the section dependent regularization stepsize constant
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section L
18-38	G21.14	Time regularization stepsize constant for section I
39-59	G21.14	Time regularization stepsize constant for section J
60-80	G21.14	Time regularization stepsize constant for section K

When using the time regularization option, the integration stepsize is determined by the integration stepsize constant (R) using the relation stepsize = period/R.

TITLE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	TITLE--keyword to identify the title card
9-11	I3	Title card identifier for second card: = 1, run identification title = 2, atmospheric density model title = 3, Earth potential model title = 4, lunar potential model title
12-80		Blank

The TITLE keyword card must be immediately followed by another card containing the title information as indicated.

Columns	Format	Description
1-72	9A8	Title information as shown above

TOF

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	TOF--keyword to set the time of flight at which sectioning is to occur
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Time of flight in seconds from epoch at which section I will end
39-59	G21.14	Time of flight in seconds from epoch at which section J will end
60-80	G21.14	Time of flight in seconds from epoch at which section K will end

A maximum of 10 flight sections is allowed. The time of flight must be a positive number.

TOLER

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	TOLER--keyword to set integration tolerances (to be used for all flight sections)
9-11	I3	Tolerance index I
12-14	I3	Tolerance index J
15-17	I3	Tolerance index K
18-38	G21.14	Tolerance associated with index I
39-59	G21.14	Tolerance associated with index J
60-80	G21.14	Tolerance associated with index K

Tolerance Index	Description	Default Value
1	Upper truncation error bound	0.25 D-7
2	Lower truncation error bound	0.25 D-13
3	Nominal truncation error bound	0.25 D-10
4	Corrector tolerance for the Cowell single-step integrator	0.50 D-8
5	Corrector tolerance for equations of motion starter	1.0 D-13
6	Corrector tolerance for variational equations starter	1.0 D-13
7	Increase factor for stepsize computation	0.2 D-0
8	Minimum stepsize	5.0 D-0 seconds
11	Maximum number of corrector iterations for Cowell single-step integrator	3

Tolerance Index	Description	Default Value
12	Maximum number of corrector iterations for Cowell multistep starter	15
13	Maximum number of step size restarts for multistep starter	5
16	Maximum relative error for Hull Runge-Kutta variable step-size integration	1.0D-3

The values for the upper truncation error bound, the lower truncation error bound, and the nominal truncation error bound will be used for all 10 flight sections unless overridden by the keywords UPPBOUND, LOWBOUND, and NOMBOUND.

TRACKELV

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	TRACKELV--keyword to set the minimum allowable elevation angle for each tracking system (default = 0.0 degrees for all tracking systems)
9-11	I3	Tracker type I (see Table 4-1)
12-14	I3	Tracker type J (see Table 4-1)
15-17	I3	Tracker type K (see Table 4-1)
18-38	G21.14	Minimum allowable elevation angle for tracker type I
39-59	G21.14	Minimum allowable elevation angle for tracker type J
60-80	G21.14	Minimum allowable elevation angle for tracker type K

TRNDLY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	TRNDLY--keyword to set the transponder delay table
9-11	I3	Table entry number (maximum value of 11)
12-17		Blank
18-38	G21.14	Transponder delay in microseconds (see Note)
39-59	G21.14	Transmission frequency in megahertz
60-80		Blank

Multiple TRNDLY cards must be used to define the entire table.

NOTE: The correction applied to the range observation in kilometers is

$$\frac{\text{speed of light (km/sec)}}{2} \bullet (\text{transponder delay } (\mu\text{sec}) - 17.1\ (\mu\text{sec})) \bullet 10^{6}$$

where 17.1 µsec is the value at VHF GRARR station for nominal zero set parameter.

TWOBODY

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	TWOBODY--keyword to set the two-body option (i.e., a point-mass gravitational force only will act on the satellite) in the force model
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section I
18-38	G21.14	Two-body option for section I
39-59	G21.14	Two-body option for section J
60-80	G21.14	Two-body option for section K

A blank or zero integer field will cause the remaining fields to be ignored. A value of 1.0 in the real fields (G21.14) will cause all perturbation options in the force model to be ignored for the specified section(s). A value of 2.0 in the first real field will have no effect. Any other values in the real fields will cause a program error. Default values for the two-body options are 2.0. A maximum of 10 flight sections is allowed.

TYPE

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EARLYORB
- Detailed format:

Columns	Format	Description
1-8	A8	TYPE--keyword to select the method for Early Orbit Determination Program computation
9-11	I3	Method to be used in Early Orbit Determination computation: = 1, fully automatic = 2, range and angles method = 3, Gauss method = 4, double-r iteration method
12-14	I3	Direction of orbital motion (necessary for the double-r iteration method only): = +1, direct motion (0° < inclination $\leq 90^{\circ}$) = -1, retrograde motion (90° < inclination $\leq 180^{\circ}$)
15-17	I3	Reference central body: = 1, Earth (only currently accepted value)
18-38	G21.14	For Gauss method and range and angles method - an estimate of the semimajor axis (kilometers) For double-r iteration method - an estimate of the geocentric distance of the first observation (kilometers)
39-59	G21.14	For double-r iteration method - an estimate of the geocentric distance of the second observation (kilometers)
60-80	G21.14	For all methods - the maximum allowable time difference in seconds between components of an observation (e.g., an X30, Y30 pair can differ by this amount and still be considered an observation pair)

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC
- Detailed format:

Columns	Format	Description
1-8	A8	UPPBOUND--keyword to set the upper truncation error bound by flight section
9-11	I3	Flight section I
12-14	I3	Flight section J
15-17	I3	Flight section K
18-38	G21.14	Upper bound for section I
39-59	G21.14	Upper bound for section J
60-80	G21.14	Upper bound for section K

A maximum of 10 sections for a flight is allowed. The upper truncation error bound initial value for all sections can optionally be set to the same value using the TOLER keyword card.

VAREPHEM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, EPHEM
- Detailed format:

Columns	Format	Description
1-8	A8	VAREPHEM--keyword to specify the interval number, the time interval for EPHEM File data records, and the height interval
9-11	I3	Interval number (n) n = 0, use time interval from OUTOPT keyword card for all height intervals (i.e., no variable time intervals; default) $2 \leq n \leq 6$, interval number
12-17		Blank
18-38	G21.14	Minimum value of satellite height for interval n (kilometers)
39-59	G21.14	Time interval for data records used in interval n (seconds)

Interval number 1 will be determined from the OUTOPT keyword card. The minimum height of interval number 1 is 0.0 kilometer. The time interval for interval number 1 will be the time interval specified in columns 60 through 80 on the OUTOPT keyword card.

WORKATM

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKATM--keyword to build the atmospheric density working file from the Atmospheric Density Models File (see Note)
9-11	I3	Model number of Harris-Priester atmospheric density table (see Appendix D, Point E; default = model 5, F = 150)
12-14	I3	Atmospheric model override flag: = 1, retrieve atmospheric model number associated with retrieved elements from the Permanent Elements File or the 24-Hour Hold Elements File. If the elements retrieved were generated using the Jacchia-Roberts Model, the Jacchia-Roberts model will be used instead of the Harris-Priester Model. = 2, use atmospheric model specified on this card and the ATMOSDEN card, regardless of the input elements source.
15-80		Blank

NOTE: File contents will be reported if so specified on the PRINTOUT keyword card.

WORKCON

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKCON--keyword to build the astrodynamic constants working file from the Astrodynamic Constants File
9-11	I3	Model number (see Appendix D, Item C)
12-80		Blank

NOTE: File contents will be reported if so specified on the PRINTOUT keyword card.

WORKELS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKELS--keyword to build the elements working file
9-11	I3	Elements source: = 0, ELEMENT1 and ELEMENT2 cards = 1, GTDS Permanent Elements File = 2, 24-Hour Hold Elements File = 4, Early orbit computation (see Note 1) = 7, PTOF
12-14	I3	For elements source 0, 1, 2, or 4: Write elements to 24-Hour Hold Elements File at end of run: = 1, Yes = 0, No (default) For elements source 7: FRN of PTOF (must be 71, 72, or 73)
15-17	I3	For elements source 0, 1, 2 or 4 only: Write elements to the Permanent Elements File at end of run: = 1, Yes = 0, No (default)
18-38	G21.14	For elements source 1 or 2: Elements set number For elements source 7: PTOF level number (see Note 2)
39-59	G21.14	For elements source 7: Time of elements to be retrieved (yymmdd.) (see Note 2)
60-80	G21.14	For elements source 7: Time of elements to be retrieved (hhmmss.ssss) (see Note 2) When columns 15 through 17 = 1: Permanent Elements File password

NOTES: 1. This option will invoke the Early Orbit Program to determine epoch elements. The user may advance the elements by supplying EPOCH, ELEMENT1, and ELEMENT2 cards with the desired epoch advance supplied on the EPOCH card.

2. For elements-source 7, either a level number or a time (or both) must be specified. If only a level number is specified, the epoch vector from that is retrieved. If only a time is specified, the level with the latest possible start time is used for the retrieval, but a -1 should be used for the level number.

3. For elements source 1, 2 or 7, the initial value of RMS will be that on the file unless overriden with an EDIT keyword card.

WORKGEO

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATAMGT, EARLYORB, ANALYSIS, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	WORKGEO--keyword to build the station geodetics working file (see Note) (The WORKGEO keyword card cannot be used with a /*******1 keyword card for the same station in the DMOPT subdeck. These keywords are mutually exclusive.)
9-11		Blank
12-14	I3	Number of stations listed on cards, called station list cards, that follow this card (see format below)
15-80		Blank

Station list card format: (10A8)

Columns	Format	Description
1-8	A8	First station name, left adjusted
9-16	A8	Second station name, left adjusted
17-24	A8	Third station name, left adjusted
⋮	⋮	⋮
73-80	A8	Tenth station name, left adjusted

Up to 20 stations may be specified using two station list cards.

For satellite-to-satellite data simulation, all transmitter stations must be listed before the transponder stations.

NOTE: File content reporting can be specified through the PRINTOUT keyword card.

WORKINT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKINT--keyword to build the working file of integration coefficients (see Note)
9-11	I3	Degree of integration for equations of motion (default = 12, minimum = 4, maximum = 19)
12-14	I3	Degree of integration for variational equations (default = 8, minimum = 4, maximum = 19)
15-80		Blank

NOTE: File contents will be reported if so specified through the PRINTOUT keyword.

WORKIONO

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DC, DATASIM, DATAMGT, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	WORKIONO--keyword to build ionospheric refraction working file (required whenever refraction corrections are to be computed) (see Note)
9-11	I3	Postflight create/save option: = 1, create working file to be released at end of run (default) = 2, create working file and also copy to save file (Bent model only) = 3, copy previously created save file to working file (Bent model only)
12-14	I3	Ionospheric refraction model to be used: = 1, Bent model (default) = 2, Novak model
15-17		Blank
18-38	G21.14	Start time of postflight working file (yymmdd; default equals earliest acceptable observation time)
39-59	G21.14	End time of postflight working file (yymmdd; default equals latest acceptable observation time)
60-80		Blank

NOTE: File content reporting is controlled by the PRINTOUT keyword. A maximum of six 10-day coefficient sets are allowed for the ionospheric working file.

WORKMAN

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKMAN--keyword to build the impulsive maneuvers working file (see Note)
9-11	I3	Retrieval mode: = 0, no maneuvers working file required = 1, retrieval by time = 2, retrieval by maneuver number
12-80		Blank

NOTE: File contents will be reported if specified on the PRINTOUT keyword card.

WORKOBS

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKOBS--keyword to specify observations input for creating a working file
9-11	I3	Source of input observations (see Note)
12-14	I3	Source of input observations (see Note)
15-17	I3	Source of input observations (see Note)
18-38	G21.14	Start time of observation span (yymmddhhmmss.ssss)
39-59	G21.14	End time of observation span (yymmddhhmmss.ssss)
60-80	G21.14	Epoch of output observations working file (yymmddhhmmss.ssss)

There is no default observation timespan or epoch. The real fields must be supplied. If more than three sources are required, multiple WORKOBS cards must be used.

NOTE: There are no default observation sources. Any desired source must be specified. If more than three sources are required, multiple WORKOBS cards must be used. There are two options for observation sources input. Option 1 is used when there is no satellite-to-satellite tracking involved. Option 2 is used when the case involves satellite-to-satellite tracking. The two options can be intermixed, but only one indicator from option 2 may be used on any set of WORKOBS cards. No source number may be used in both options. The source numbers for options 1 and 2 are given below. The FORTRAN Reference Number (in parentheses) follows the source. See Section 5 for JCL considerations. This card must not be used in any program input deck that contains an OBSINPUT keyword card.

Option 1

Source Number	Source	Source Number	Source
1	GTDS observations tape (FT29)	7	G-WWW tape, 9-track (FT40)
2	GTDS observations disk (FT31)	8	60-byte data base (FT96)
3	DODS observations tape (FT30)	9	Landmark data card file (FT15)
4	Real-time 60-byte metric tracking data file (partial batch)	10	Landmark data card file (FT15)
5	GTDS card file (FT15)	11	Observations working file previously created (FT17)
6	Attitude sensor (optical aspect) 9-track tape (FT94)	12	GDH 60-byte format tape (FT91)

Option 2

Option 2 must be used whenever

1. Satellite-to-satellite tracking for ATS is involved.

2. TDRS tracking data is involved. (This includes satellite-to-satellite data, relay track of ground transponders, and direct track of a TDRS relay satellite.)

   a. ATS--The source indicator IJK is a packed integer

      where I indicates the source of the satellite-to-satellite relay data

      J indicates the source of ATS tracking data

      K indicates the source of target satellite tracking data

Option 2 (Cont'd)

b. TDRS--The source indicator IJK is a packed integer

where I indicates the source of the satellite-to-satellite relay data and relay-ground track

J indicates the source of the direct tracking of the TDRS relay satellites

K indicates the source of target satellite tracking data

The following source numbers apply to I, J, and K:

Source Number	Source	Source Number	Source
1	No data of this type	8	60-byte data base (FT96)
2	GDH tape (FT91)		

Specifying a 1 on any integer means that data will not be searched for on any input source.

Examples:

```
Column 1          11        20              40
       ↓          ↓         ↓               ↓
       WORKOBS    818       start time      end time.
```

specifies that ATS or TDRSS satellite-to-satellite data will be found on the 60-byte data base (source 8), that there will be no direct tracking of the relay satellites requested, and that the source of the direct tracking of the target satellite will be the 60-byte data base.

Option 2 (Cont'd)

specifies that ATS or TDRS satellite-to-satellite data will be found on a 60-byte observation tape (source 2) and that there will be no direct tracking of either the relays or target satellite.

NOTE: The use of real-time 60-byte (source number 4) data must be indicated under Option 1. Source number 4 is not a valid entry under Option 2; real-time tracking data for a TDRS run may be obtained by intermixing Option 2 and Option 1, with source number 4 specified. More specific control over the real-time data source is provided by the keyword cards RTPARAMS, RTSATID, RSTA****, and RSYS****.

WORKSECT

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKSECT--keyword to build the flight sectioning working file (see Note)
9-11	I3	Flight sectioning model number (see Appendix D, Item D)
12-80		Blank

NOTE: Printout of the file contents may be controlled via the PRINTOUT keyword.

WORKTCOR

- Card format: (A8, 3I3, 3G21.14)
- Applicable programs: EPHEM, DC, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	WORKTCOR--keyword to retrieve data from the Time Conversion Coefficient File (see Note)
9-11	I3	Time Conversion Coefficient File retrieval indicator: = 0, no > 0, yes
12-80		Blank

NOTE: Report of file contents is controlled by the PRINTOUT keyword card.

/*******1 (Station Card 1)

- Card format: (A8, I1, 1X, I4, I3, 3G21.14)
- Applicable programs: DC, EARLYORB, DATASIM, ANALYSIS, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	/*******1 where the asterisks represent the station name
9	I1	1 (card number)--defines the Station Card number, (Station Card 1 defines the station type and position: see Note 1)
10-14	I5	Station index number (see Appendix A, Table A-5) (see Note 2)
15-17	I3	Station type: = 1, VHF = 2, Minitrack = 3, C-Band = 4, S-Band = 5, USB - 30-foot = 6, USB - 85-foot = 7, SRE-VHF = 8, ATSR = 9, ATSR Ground Transponder = 10, DNS = 11, SRE - S-Band = 12, Laser = 13, Optical = 14, X-Y Parabolic = 15, TDRSS = 16, TDRSS Ground Transponder = 17, SGLS
18-38	G21.14	Height above or below sea level in meters (see Note 3)
39-59	G21.14	Geodetic latitude (±ddmmss.ssss) (see Note 3)
60-80	G21.14	East longitude (dddmmss.ssss) (see Note 3)

/********1
Station Card 1
(DCOPT, DMOPT)

NOTES:

1. The Station Card 1 keyword must precede the Station Card 5 keyword for any given station.

2. For mobile laser stations the station index number is a 5-digit integer CCCMM, where CCC represents the 3-digit station index number as in Table A-5, and MM represents the mobile laser move number appropriate to the geodetics requested. For other station types the station index number is the 3-digit number as in Table A-5. Note mobile lasers are recognized as index numbers 221 through 245 only.

3. Default values are supplied from the Tracking Station Geodetics File if this field is blank or zero and this keyword card is in a DCOPT subdeck.

/*******2 (Station Card 2)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DC, EARLYORB, DATASIM, ANALYSIS, DATAMGT
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	2 (card number) - defines the Station Card number (Station Card 2 defines station-dependent data)
10-11		Blank
12-14	I3	Ellipsoid model number (the default ellipsoid model is ae = 6378.166 kilometers, 1/f = 298.300) (see ELLMODEL card description)
15-17	I3	Antenna offset (meters) (see Note)
18-38	G21.14	N-S vertical deflection (seconds of arc) (see Note)
39-59	G21.14	E-W deflection (seconds of arc) (see Note)
60-80	G21.14	Transmitter frequency (megahertz) (see Note)

NOTE: Default values are supplied from the Tracking Station Geodetics Files if the field is blank or zero and this keyword card is in a DCOPT subdeck.

/*******3 (Station Card 3)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DC
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	3 (card number) - defines the Station Card number (Station Card 3 defines observation types by station for DC residual plots)
10-11	I2	Number of observation types to be plotted (input 4 if every observation type for this station is to be plotted)
12-17		Blank
18-38	G21.14	Observation type to be plotted
39-59	G21.14	Observation type to be plotted
60-80	G21.14	Observation type to be plotted

See Table A-2 in Appendix A for observation type numbers.

If every observation type for this station is to be plotted, columns 18 through 80 need not be specified.

/*******4 (Station Card 4)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DC, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	4 (card number) - defines the Station Card number (Station Card 4 defines the standard deviation of the station position when solving for station position)
10-11		Blank
12-14	I3	Solve for station position: > 0, yes = 0, no
15-17		Blank
18-38	G21.14	Standard deviation of X station coordinate (kilometers)
39-59	G21.14	Standard deviation of Y station coordinate (kilometers)
60-80	G21.14	Standard deviation of Z station coordinate (kilometers)

/*******5 (Station Card 5)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DC, ANALYSIS, DATASIM
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the tracker acronym (in the case of observation biases) or the ground transponder acronym (in the case of transponder delay)
9	I1	5 (card number) - defines the Station Card number (Station Card 5 defines observation bias information (corresponds to Table A-2 in Appendix A) or ground transponder delay information
10-11	I2	= blank, observation bias = 1, transponder delay
12-14	I3	Observation type (corresponds to Table A-2 in Appendix A) in the case of observation bias (when columns 10-11 = blank) = 30, for timing bias Solve-for switch in the case of ground transponder (when column 10-11 = 1): = 0, apply transponder delay = 1, apply and solve for transponder delay
15-17	I3	Number of bias passes required (if nonzero, solve for selected bias)--This field is blank for ground transponder delay (see Note)
18-38	G21.14	A priori bias value (in meters, seconds, centimeters/second, seconds of arc, or hertz, depending on the observation type) or transponder delay

NOTE: If this field is nonzero, a PASSTIME card is required to define the time limits of the pass.

/*******5
Station Card 5
(DCOPT)

Columns	Format	Description
39-59	G21.14	A priori bias (in meters, seconds, centimeters/second, seconds of arc, or hertz, depending on the observation type) or transponder delay standard deviation
60-80	G21.14	Minitrack or gimbal angle error model bias indicator (see next page)

This card must follow the Station Card 1 for any given tracker if the tracker type has been modified on Station Card 1.

The ground transponder delay specified by this card is the interval in seconds between the receipt of the signal by the ground transponder and the retransmission of the signal.

For a minitrack error model bias:

1.0 = equatorial, zero-set bias
2.0 = equatorial, scale factor
3.0 = equatorial, misalignment error
4.0 = equatorial, timing bias
11.0 = polar, zero-set bias
12.0 = polar, scale factor
13.0 = polar, misalignment error
14.0 = polar, timing bias

The timing bias will be applied or solved for L and M simultaneously whether or not a 2 or 3 is specified as the observation type (in column 14).

For a gimbal angle error model bias:

1.0 = X-angle encoder bias less tilt eastward of upward normal to the antenna (positive if encoder reading is too high)

/*******5
Station Card 5
(DCOPT)

2.0 = elevation deflection associated with X-direction (structural sag downward less quadruple droop downward)

3.0 = Y-axis to X-axis lack of orthogonality (subtract coefficient from 90°)

4.0 = RF axis to Y-axis lack of orthogonality (subtract coefficient from 90°)

5.0 = tilt of north end of X-axis upward

6.0 = tilt of north end of X-axis eastward

7.0 = Y angle encoder bias less RF- to X-axis lack of orthogonality (positive if encoder reading is too high)

8.0 = elevation deflection associated with Y-direction (structural sag downward less quadruple droop downward). For X85, Y85 replace eastward in 1 and 6 with southward and replace north in 5 and 6 with east.

A maximum of four Minitrack error model biases or four gimbal angle error model biases can be applied or solved for a station or stations of the same type (a separate Station Card 5 keyword must be input for each bias). If four biases are specified for a given station and error modeling is to be done for other stations of the same type, biases selected must be chosen from the four already used.

/*******6 (Station Card 6)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DC, DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	6 (card number) - defines Station Card number. Station Card 6 defines observation corrections for a given station
10-11	I2	Light time correction indicator: = 0, ignore this field = 1, perform light time correction = 2, do not perform light time correction
12-14	I3	Ionospheric refraction correction indicator: = 0, ignore this field = 1, perform a refraction correction = 2, do not perform a refraction correction
15-17	I3	Tropospheric refraction correction indicator: = 0, ignore this field = 1, perform a refraction correction = 2, do not perform a refraction correction
18-38	G21.14	Antenna mount correction indicator: = 0, ignore this field = 1, perform antenna mount correction = 2, do not perform antenna mount correction
39-59	G21.14	Transponder delay correction indicator: = 0, ignore this field = 1, perform transponder delay correction = 2, do not perform transponder delay correction
60-80		Blank

/********6
Station Card 6
(DCOPT)

See Table A-3 of Appendix A for correction type by observation type.

Note that the use of the Station 6 card requires the use of an OBSCORR keyword card to input the frequency and beginning iteration number at which observation corrections are applied. The Station 6 cards override the correction settings defined in the packed word on the OBSCORR card. Also note that there are two models in GTDS for computing the refraction corrections: the Bent model and the Novak model. The default model is the Bent model. The user can override this default via proper input on a WORKIONO keyword card in a DMOPT subdeck. If the ionospheric refraction switch is turned on, a WORKIONO keyword card is always required in order to build an ionospheric refraction working file.

/*******7 (Station Card 7)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	7 (card number) - defines the Station Card number (Station Card 7 defines miscellaneous schedule data)
10-11	I2	Number of tracking intervals for the station, n (see Note 1)
12-14	I3	Type of special event to be used for a station (see Note 2): = 1, apogee = 2, perigee (default)
15-17	I3	Number of periodic intervals used (default = 1; use with tracking schedule type 1 only)
18-38	G21.14	Rate at which to compute observations (seconds) (see Note 3)
39-59	G21.14	Specific time values (see Note 4)
60-80	G21.14	Elevation at which to start and end a satellite pass (degrees)

NOTES: 1. For tracking schedule type 1, the number of intervals (n) per period (default = 1, $1 \leq n \leq 10$)

For tracking schedule type 2, the number of passes to use for this station (default = 10, $1 \leq n \leq 999$)

For tracking schedule type 3, the number of special events to use for this station (default = 10, $1 \leq n \leq 999$)

For tracking schedule type 4, defaults automatically to 1

/********7
Station Card 7
(DCOPT)

2. Use with tracking schedule type 3. The tracking schedule type is entered in column 11 of the DSPEA1 card.

3. This value defaults to the number specified on the third real field of the DSPEA1 keyword card. (Not used with tracking schedule type 4.)

4. For tracking schedule type 1, this field is the periodic time interval in hours (default = 24)

   For tracking schedule type 2, this field is the number of seconds to observe a satellite in a pass (default = 300)

   For tracking schedule type 3, this field is the interval in seconds centered about the special event to observe the satellite (default = 600)

   For tracking schedule type 4, not applicable

   The tracking schedule type is specified in columns 9 through 11 of the DSPEA1 keyword card.

/*******8 (Station Card 8)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	8 (card number - defines Station Card number (Station Card 8 specifies the type of observations and station errors to be used)
10-11	I2	Type of observation to be computed
12-14	I3	Type of observation to be computed
15-17	I3	Type of observation to be computed
18-38	G21.14	Error in station height (meters) (default = 0.0)
39-59	G21.14	Error in station latitude (=ddmmss.s) (default = 0.0)
60-80	G21.14	Error in station longitude (=ddmmss.s) (default = 0.0)

The type of observation to be computed defaults to permissible observation types from a station as defined on the third integer field (columns 15 through 17) of Station Card 1 (e.g., if this is a Minitrack station and columns 10 through 17 are blank, or if this card is omitted, then Minitrack observations ℓ and m will be computed). For a table of acceptable observation types, see Appendix A.2.

/*******9 (Station Card 9)

- Card format: (A8, I1, I2, 2I3, 3G21.14)
- Applicable programs: DATASIM, ANALYSIS
- Detailed format:

Columns	Format	Description
1-8	A8	/******* where the asterisks represent the station name
9	I1	9 (card number - defines Station Card number (Station Card 9 defines tracking interval data)
10-11	I2	Tracking interval number
12-17		Blank
18-38	G21.14	Start time of input tracking interval (yymmddhhmmss.)
39-59	G21.14	End time of input tracking interval (yymmddhhmmss.)
60-80	G21.14	Time delay for range difference in seconds (default = 0.01)

The I1, R1, and R2 fields are used only for tracking schedule type 1 or tracking schedule type 2 (column 11 of the DSPEA1 keyword card). For tracking schedule type 2, the I1 field must be 1.

The tracking intervals must be in chronological order for a given station.

SECTION 5 - JCL REQUIREMENTS

5.1 INTRODUCTION

The preceding sections of this guide have dealt with the input card decks required to run GTDS. However, even with correct input card decks, the user cannot execute the system on the GSFC NAS AS/8040R1 and R2 computers unless the proper JCL cards have been provided. The JCL cards specify the input files, output files, temporary data sets, and accounting information required by GTDS and the FDF Operating System/Virtual Storage 2 (OS/VS2). Missing or incorrect JCL cards can result in job failure. It is assumed that the GTDS user has a basic knowledge of OS/VS2 JCL. This document does not attempt to teach a complete JCL course but rather to summarize GTDS-related JCL. Those who desire further information on OS/VS2 JCL should consult References 18 and 19.

Three JCL cards are always required to execute GTDS: the JOB card, an EXEC card, and a data definition (DD) card. The JOB card specifies the job name, programmer identifier, accounting information, computer time usage estimates, and JCL print output options. The format of the JOB card is installation dependent; for the specific GSFC JOB card format, consult the FDF Programmer Assistance Center (PAC).

An EXEC card to invoke the GTDS cataloged procedure is the next required JCL card. A cataloged procedure, a set of JCL statements maintained in the system procedure library, is used to limit the number of JCL cards that the user is required to input with the input deck. Figure 5-1 (at the end of Section 5) lists the GTDS procedure, which is also named GTDS. By supplying a single EXEC card and thereby referencing the GTDS procedure, the user can introduce the JCL

required for standard GTDS cases into the input stream. The last JCL card required for all GTDS jobs is a DD card, which defines the characteristics of the input card data set (i.e., the keyword card input deck). This DD card is usually the last JCL card for each GTDS job and is followed by the card input decks (keywords).

The three required JCL cards just described are coded as follows:

```
//USRIDGTD JOB (GR123,456H,AAA),TIME=M,S)    (JCL card 1)
//       EXEC    GTDS                        (JCL card 2)
//GO.DATA5       DD *                        (JCL card 3)
Keyword card 1 )
      .        )
      .        )  input card deck
      .        )
Keyword card n )
//
```

Note that JCL card 1 is the JOB card, JCL card 2 introduces the GTDS procedure into stream, and JCL card 3 is the input DD card.

A second procedure is available for the user who wishes to make a temporary update to the GTDS system prior to execution. This procedure, called GTDSMOD, contains the JCL required to update subroutines, compile updated subroutines, link updated subroutines with the nonupdated GTDS system, and execute the updated system. Figure 5-2 (at the end of Section 5) contains a listing of the procedure. The JCL needed to use UCLEG is as follows:

```
//USRIDGTD JOB (GR123,456H,AAA),TIME=(M,S)
//       EXEC    UCLEG
//PUPAM.DATAM DD *
Update cards for A-M subroutines
//PUPNZ.DATNZ DD *
```

Update cards for N-Z subroutines

```
//GO.DATA5    DD *

Keyword card 1 ┐
      .        │
      .        ├ GTDS keyword
      .        │ input card deck
Keyword card n ┘
//
```

There will be times when a user will need to modify or add to those JCL cards in the procedure. In these cases, the procedure may still be used, but the modified or additional information must be included with additional JCL. Any user unfamiliar with JCL for OS/VS2 should consult an OS/VS2 JCL manual (Reference 14) or the FDF PAC before attempting to change or add to JCL already in the procedure.

The following part of this section is addressed to the user familiar with JCL. Both the GTDS and UCLEG procedures are discussed card by card. A short section on the use of the GTDS update utility PACKUPD is included for users who will be performing temporary updates to GTDS subroutines. In addition, parameters that appear in the GTDS and UCLEG procedures are discussed.

5.2 GTDS PROCEDURE

The GTDS procedure exists in the FDF R1 and R2 computers. The procedure (see Figure 5-1) points the system to the load module or program that is to be executed in the GO step and sets up default values for symbolic parameters. The GO step is the step in which the load module is actually executed. The GO step, along with the symbolic parameters, is discussed in detail in the remainder of this section.

5.2.1 SYMBOLIC PARAMETERS

The GTDS procedure contains various symbolic parameters. The DELTA symbolic parameter points to the load module to be

executed. By default, this load module is the operational version of GTDS. However, if a modified or development load module is stored on disk, the user can force the procedure to access that modified or development load module instead of the operational one with a single JCL override.

The GTDS production load module is maintained at GSFC on the FDF R1 and R2 computers. The data set name (DSN) for the production load module is ORBIT.GTDS.LOADMOD.LOAD(GTDS).

By overriding the DELTA parameter, the user can point to any load module for which execution is desired in the GO step.

The BASE symbolic parameter points to the data set that contains the load modules needed whenever dedicated printer output is specified during an interactive graphics run. The default for this parameter is ORBIT.GTDS.LOADMOD.LOAD.

The MEM symbolic parameter defines the member name of the GTDS load module to be executed. The default value is GTDS.

The OUTPUT symbolic parameter directs SYSOUT output to the desired output device. The default is SYSOUT = A (for line printer output).

The GRAPH symbolic parameter is used to control the allocation of data sets needed for an interactive graphics run. The default is DUMMY, which means that the graphics data sets are not normally allocated. In order to run graphics, one must supply the override GRAPH= to allocate the graphics data set.

The UNIT parameter defines the graphics device to be used during a graphics run. The default is 2250-1, which points the system to an available IBM 2250 device. Care must be taken to ensure that the desired device is actually available; otherwise, the graphics run will fail. The CODE1 and CODE2 symbolic parameters define which condition codes

from a previous job step will allow the GO step to be executed. The default is to accept a previous completion code of less than eight.

A parameter named PRF allows the user to specify his own high-level prefix for the data base files used by GTDS. The default is ORBIT.

Two parameters named DSK and DSK1 allow the user to specify the unit type for disk files created or used by GTDS. The default for both is DISK. The alternative specification is 3350.

A parameter, B, specifies the number of input/output buffers allocated by the system for GTDS disk files. The default is 1.

The URCPCH symbolic is used to control the allocation of the punch data set for User Receive Center punched output. The default is DUMMY. Specifying URCPCH = allocates the data set.

A parameter named SOREXT is provided to specify the tape volume for the SOR Extract File. This data set is defined as DUMMY in the GTDS procedure and an override must be provided to specify a DSN for the data set.

5.2.2 GO STEP

The GO step in the GTDS procedure is the step for actual execution of the load module. The first card in this step also causes OS/VS2 to execute a program. The system is directed to execute the load module or program indicated by the DELTA symbolic parameter (normally the operational GTDS load module). In addition, the REGION size or the amount of core to be allocated to execution of the load module is indicated, along with acceptable completion codes.

All remaining cards in the GO step are DD cards pointing to data sets or files that may be needed during execution. Each DD card is described in the following paragraphs.

FT00F001 - The THMODEL Program contains a permanent dummy for output suppression.

FT01F001 - The Report Index File contains a list of GTDS reports generated by the run and the page number of the GTDS output on which each report begins.

FT02F001* - The Atmospheric Density Models File contains various sets or models of atmospheric density data used by GTDS in drag computations.

FT03F001* - The Impulsive Maneuvers File contains maneuver information for various missions and is used in thrusting computations. This file is not currently used.

FT04F001* - The Astrodynamic Constants File contains physical and astrodynamic constants used throughout GTDS.

FT05F001 - By providing a DDNAME of DATA5, this JCL card points to the keyword card input that follows the DATA5 DD card.

FT06F001 - The printer output is accumulated in this data set during GTDS execution and is routed to the printer after execution has terminated in a batch run. Graphics runs can also route printout to a dedicated printer during execution.

---

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

FT07F001 - Punched output requests are accumulated here and are punched at job completion time.

FT08F001* - The Earth Potential Fields File contains data relating to the Earth's potential field. The data are accessed when Earth potential field data other than that in COMMON block storage is required.

FT09F001* - The Lunar Potential Fields File contains lunar potential field data, used similarly to the data on FT08F001.

FT10F001* - The Integration Coefficients File contains integration coefficients that are referenced as needed (generally when the default integration order has been modified).

FT11F001* - The Flight Sectioning Models File contains sectioning models for various missions. It is referenced when a WORKSECT keyword is used to build a working flight sectioning file.

FT12F001**- The temporary cathode ray tube (CRT) input data set is used to store keyword card images when GTDS is being run in the interactive mode.

FT13F001* - The Error Messages File contains all the numbered GTDS error messages in EBCDIC format; it is accessed by GTDS whenever specified errors occur.

---

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT14F001* - The SLP Ephemeris File contains planetary ephemeris data referenced to a mean of 1950.0 coordinate system and is used throughout GTDS.

FT15F001 - The observation card input data set may be input directly via FT15F001 or by a separate DD card (OBSCARDS). In either case, the observation cards must immediately follow the DD card. Thus, if observation input by card is specified via the WORKOBS or OBSINPUT keywords, either an OBSCARDS or an FT15F001 DD is required. The form is

```
//GO.FT15F001   DD   *
{observation}
{card       }
{deck       }
```

or

```
//GO.OBSCARDS   DD   *
{observation}
{card       }
{deck       }
```

See Section 3.4.7.

FT16F001 - The data simulation summary data set contains information for the Data Simulation Summary Report of the Station Contact Report. If neither of these reports is to be generated, the file is not used, and input/output (I/O) time requirements are reduced. Both reports are controlled by the DSPEA3 keyword card.

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

FT17F001 - The Observations Working File data set is created whenever an OBSINPUT or WORKOBS keyword is used. The file contains all observations eligible for use in the Differential Correction (DC) Program.

FT18F001 - The SLP Working File data set is used whenever a user elects to create his or her own SLP file rather than use either of the permanent files defined on FT14F001 or FT78F001. The process is controlled via the SLPFILE keyword card. Note that the space allocated for this file cannot be increased in the JCL without a corresponding program modification to the DEFINE FILE statement (in subroutine SETDAF) for unit 18.

FT19F001 - The direct-access primary ORBIT File with partial derivatives is used whenever the user wants to input or output a direct ORBIT File with partial derivatives. This file is also used as a scratch file for some options that require an intermediate ORBIT File. The JCL card must be overridden only when the file is used as input or when the output file is to be saved. The keyword cards that might require such an override are CMPEPHEM, DSPEA2, ORBTYPE, and OUTOPT.

FT20F001 - The direct-access primary ORBIT File without partial derivatives is used when a request for such a file as input or output is made. The data set is dummy by default and must be overriden to be activated. This may be required if any of the following keywords are used: CMPEPHEM, DSPEA2, ORBTYPE, and OUTOPT.

FT21F001 - The sequential primary ORBIT File with partial derivatives is used in the same way as FT20F001. The same restrictions apply. Note that the file defaults to tape rather than to disk.

FT22F001 - The sequential primary ORBIT File without partial derivatives is also a tape data set by default; it is used in the same way as FT20F001.

FT23F001**- The graphics error message data set provides basically the same diagnostic information for graphics display as that generated on the printer.

FT24F001 - The primary ORB1 File or EPHEM File may be needed as either an input or an output file. Keyword cards that may indicate use of the file are CMPEPHEM, DSPEA2, and OUTOPT. This file is the first input file for EPHEM File merge (EPHMERGE).

FT25F001* - The GTDS Permanent Elements File contains orbital elements for various satellites. These elements may be referenced for use as initial elements in any of the GTDS programs that require initial elements.

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT26F001* - The 24-Hour Hold Elements File is a short-term storage file for orbital elements. During a GTDS run, elements may be stored on (and later retrieved from) this file.

FT27F001* - The Tracking Station Geodetics File contains station geodetics information used to create a working geodetics file for those GTDS programs that require station information. The WORKGEO keyword card specifies requests for data from this file related to particular stations.

FT28F001**- The graphics satellite ephemeris data set is used to store satellite ephemeris information for graphics displays during an EPHEM Program execution.

FT29F001 - The GTDS Observations Tape File is a data set containing observations in the sequential GTDS format. Although it is normally a dummy data set, it may be required if either a DSPEA1, OBSINPUT, or WORKOBS keyword card is used. When needed, a JCL override card is required to validate the file.

FT30F001 - The DODS observation tape data set provides observation input in the sequential DODS format. The data set is dummy by default and must be overridden if needed. Keyword

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

cards that may require the file are DSPEA2, OBSINPUT, and WORKOBS. This format is no longer maintained for GSFC operational use, although GTDS can use data in this format.

FT31F001 - The GTDS observation disk data set provides a direct-access observation file in the same format as the GTDS Observations File (FT29F001). If the use of this file is indicated on the OBSINPUT or WORKOBS keyword card, an override must be provided to point to the valid data set.

FT32F001 - The 60-byte Partial Batch Data File contains real-time (partial batch) tracking data requested by GTDS on the Request File (FT56). FT32 is dynamically allocated by GTDS, written to by the tracking data preprocessing program of TCOPS, and deleted by GTDS after use. Only a DD dummy statement need be supplied for FT32.

FT33F001 - The SLP tape may be used as either input or output in an SLP File creation process. That is, the SLPFILE keyword card may specify an SLP tape as either an input file or an output file. In either case, FT33F001 must be overridden.

FT34F001 - The JPL DE-96 tape is used as an input data source for SLP File creation. If the old DE-19 JPL tape is specified as input on the SLPFILE keyword card, a JCL override is required. See the SLPFILE keyword card for the DCB override for the DE-19 tape.

FT35F001**- The graphics integration statistics data set is used to store statistical information for later graphics display during an EPHEM Program run.

FT36F001**- The graphics orbit generator summary data set is also used to store ephemeris generation information for later display.

FT37F001 - The Observation Sort File is a working data set used when sorting is required to ensure that observation input data are time sorted whenever more than one observation input source is used.

FT38F001* - The Time Conversion Coefficients File contains timing conversion and polar motion data that may be accessed throughout GTDS runs.

FT39F001* - The Ionospheric Refraction Generalized Coefficients File is used in the computation of ionospheric refraction corrections.

FT40F001 - This data set is used for a graphics display of the Permanent File Reports.

FT41F001 - The temporary starter arrays data set is used by the integrator whenever a change in integration direction is required during integration.

---

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT42F001**- The graphics observation residual data set holds the residual report generated during an iteration so that it may be displayed at the end of that iteration. This data set is also used to hold residuals to be plotted by the printer plot package. The Ephemeris Comparison (COMPARE) Program printer plots also use this file.

FT43F001**- The graphics solve-for parameter data set contains solve-for parameter information for display during a DC Program run and comparison difference information for display during a COMPARE Program run.

FT44F001**- The graphics elements data set also contains comparison differences for the COMPARE Program as well as an elements report for the DC Program.

FT45F001 - The scratch ORBIT File is used when multiple sets of observations are used (e.g., tracking data plus attitude sensor data).

FT46F001 - The Observations Save File data set is used whenever a user requests the Observations Working File to be saved via the keyword card SAVE. In this case, an override is required to activate the normally dummy data set.

---

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT47F001 - The user receive center (URC) frequency punched output file is used to accommodate the separation of punched output when the URC frequencies are requested to be calculated and punched (SELOUT card).

FT48F001 - This data set is used as a working file for Earth and lunar potential fields data.

FT49F001** - The graphics DC Program Summary Report data set holds the DC Program Summary Report during a DC Program run and the Data Simulation Observation Report during a Data Simulation (DATASIM) Program run whenever the graphics option is used.

FT50F001 - The real-time tracking data acquisition summary data set may be provided via FT50F001 or via DD card DODSUM. In either case, the data set contains summary information on the tracking data received. (The DODS real-time capability is no longer supported in GTDS).

FT51F001 - The standard DC Program Elements Report is a single-page summary report of the final DC Program elements. The report is generated on the printer and may later be used for teletype transmission. If the teletype report is desired, an override card must be provided.

FT52F001 - The data simulation DODS input tape is required by the DATASIM Program for a type 4 tracking schedule. If the option has been selected on the DSPEA1 card, an override is required to point to a valid data set.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT53F001 - The Computer-Assisted Interactive Resource Scheduling (CAIRS) Orbit Determination Report data set provides information to the launch support team during a support operation. Information is written to this data set by GTDS at the end of each DC Program run with the graphics REALTIME option on the CONTROL keyword card. An override is required for the CAIRS file to be updated.

FT54F001 - The Chebyshev ephemeris tape may be generated by GTDS for use on a PDP-11 computer. If this option is requested by the OUTOPT keyword, an override card is required.

FT55F001 - The CRT is required for the interactive mode. When running in the interactive mode, an IBM 2250 is allocated to the job via this unit automatically.

FT56F001 - The Request File contain requests written by GTDS for the data collection program of TCOPS to provide 60-byte partial batch (real-time) data.

FT57F001 - The COMMON block default values data set is used to save the initial or default values for GTDS-labeled COMMON blocks so they may be restored on request.

FT58F001 - The Ionospheric Refraction Working File data set (Novak model) is used for the working file created when refraction correction using the Novak file is requested.

FT59F001* - The Solar Flux Data File contains solar flux data used in the computation of solar radiation and ionospheric refraction effects.

FT60F001* - The GTDS Accounting Information File provides a running account identifying GTDS users and the types of GTDS programs being executed.

FT61F001 - The Residual Edit Working File is used by the residual editor during the DC iteration process.

FT62F001 - Tracking Data Validation Extract File is used by offline programs to process residual plot.

FT63F001 - The Flight Director's Report provides the flight director with a summary of what is happening with GTDS during a support operation. GTDS provides information to this report through this data set whenever the graphics REALTIME option is specified on the CONTROL keyword card for a DC Program run. An override is required in this case.

FT64F001 - The SOR Extract File is used by offline programs to process SOR residual data and validation and calibration data. For magnetic tape output of the SOR extract the following JCL card override is needed:

```
//GO.FT64F001 DD UNIT=2400-4,DISP=(,PASS),
//  DCB=(RECFM=VBS,LRECL=132,BLKSIZE=3304,
      BUFNO=1),
//  LABEL=(1,BLP),VOL=SER=tapenumber
```

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

FT65F001 - The intermediate Ionospheric Refraction Coefficients Working File data set is used when ionospheric refraction correction (Bent model) is requested.

FT66F001 - The intermediate Ionospheric Refraction Coefficients Working File save data set is used to save the intermediate file on request. The request may be made via the WORKIONO keyword. The save file may be used as input at a later date, also through the WORKIONO keyword.

FT67F001 - The data set for real-time refraction coefficients as a function of universal time is not currently implemented.

FT68F001* - The Tropospheric Data File (scale height and refractivity) is used by the Bent model for ionospheric refraction corrections.

FT69F001** - The Graphics Prompting File is used to provide prompting messages (or instructive text) to the user when the user is running in the interactive mode. The messages are designed to assist the user in execution of interactive graphics options.

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT70F001 - The sequential card image data set is used in a graphics run if a request to modify sequential input is made from the CRT input menu display in the prompting mode. The data set should consist of one or more keyword card input decks.

FT71F001 - This permanent ORBIT File is used for a TDRS ephemeris. An override is needed to activate the normally dummy data set.

FT72F001 - This permanent ORBIT File is used for a TDRS ephemeris. An override is needed to activate the normally dummy data set.

FT73F001 - This permanent ORBIT File is used for a TDRS ephemeris. An override is needed to activate the normally dummy data set.

FT74F001** - The graphics interrupt data set contains a record of all operator actions taken during an interactive graphics session.

FT75F001* - The Jacchia Atmosphere File is accessed when atmospheric density tables based on the Jacchia-Roberts atmosphere model are requested.

FT76F001 - The GMAN output file contains mass/thrust tables.

---

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

**The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

FT77F001 - The working ORB1/EPHEM File is used internally by GTDS in the generation of ORB1/EPHEM Files that are not strictly time ordered.

FT78F001* - The SLP File [true-of-date (TOD) coordinates] contains planetary ephemeris data and is accessed throughout GTDS computation when the user has specified TOD coordinates for the integration.

FT79F001 - The FSF is used as an output of the THMODEL Program and as an input to the EPHEM Program for an orbit propagation through burns (invoked by the keyword BURNFSF).

FT80F001 - The scratch ORBIT File is used for the target satellite in runs that process TDRSS or ATSR tracking data. An override card is needed to activate the normally dummy data set.

FT81F001 - The secondary ORB1/EPHEM File may be used as input or output in GTDS. An override is required if any of the following keyword cards specifies use of the file: CMPEPHEM, DSPEA2, or OUTOPT. This file is the second input file for EPHEM merge (EPHMERGE).

FT82F001 - The sequential secondary ORBIT File with partial derivatives is used in the same way as FT20F001.

*These files are part of the GTDS permanent data base. The JCL card pointing to these files should not be overridden unless the user is purposely accessing data from some source other than the GTDS permanent data base.

FT83F001 - The third ORB1/EPHEM File is used just as FT81F001 is used. OUTPUT file for EPHEM merge (EPHMERGE).

FT84F001 - The sequential secondary ORBIT File without partial derivatives is used in the same way as FT20F001.

FT85F001 - The fourth ORB1/EPHEM File is used in the same way as FT81F001.

FT86F001 - The direct-access secondary ORBIT File with partial derivatives is used in the same way as FT20F001.

FT87F001 - The fifth ORB1/EPHEM File is used in the same way as FT81F001.

FT88F001 - The direct-access secondary ORBIT File without partial derivatives is used in the same way as FT20F001.

FT89F001 - The Graphics Acceleration File is not in the procedure at this time.

FT90F001 - Spare--not in the procedure at this time.

FT91F001 - The GDH sequential observation data set is required whenever the GDH sequential observation source is specified as input on either the WORKOBS or OBSINPUT keyword cards. An override is required to validate the file for these keywords.

FT92F001 - The Error Analysis (ANALYSIS) Program Summary Report data set is used to accumulate ANALYSIS Program information for a printer report.

FT93F001 - The error analysis data set

FT94F001 - The attitude sensor data set is an observation source available to GTDS. An override is required for this data set if either the WORKOBS or OBSINPUT keyword card specifies optical aspect data as input.

FT95F001 - The SOR File contains observation residuals and data batching information that are used for tracking station validation and calibration statistics.

FT96F001 - The 60-byte permanent observation data base contains data in the GDH output format.

FT97F001 - The scratch ORBIT File for a relay satellite is used to process TDRSS or ATSR tracking data.

FT98F001 - The scratch ORBIT File for a relay satellite is used to process TDRSS tracking data.

FT99F001 - The scratch ORBIT File for a relay satellite is used to process TDRSS tracking data.

INPUTPDS - The CRT Input File is a partitioned data set; each of its members contains a keyword card input deck. The data set is used when GTDS is run in the interactive mode and the user elects to submit one of the members to the input processor. If the partitioned data set option is to be used in a graphics run, an override JCL card must be supplied to point to a valid partitioned data set. The Data Control Block (DCB) of the data set must be DCB=(RECFM=FB,LRECL=80, BLKSIZE=7200).

NUCLEUS - The nucleus data set provides GTDS with system accounting information.

SYSUDUMP - The dump data set provides the user with a core dump when abnormal termination of the job occurs.

ERRDUMP* - The graphics dump data set allows the user to dump core whenever an abnormal termination occurs in a graphics job. Following completion of the dump, the user may continue the job by submitting a new keyword card input deck.

Other JCL cards that may be required are those cards that activate the dedicated printer. This option is strictly for the operational support mode and should not be used at other times. The following cards are required:

```
//GO.FT06F001   DD DSN=DEDOUT,DISP=(NEW,DELETE),UNIT=3350,
//              DCB=(RECFM=VBA,LRECL=137,BLKSIZE=6169),
//              SPACE=(6169,(600),,CONTIG)
//GO.DEDIN      DD DSN=DEDOUT,VOL=REF=*.GO.FT06F001,UNIT=3350,
//              DISP=SHR
//GO.DEDOUT     DD UNIT=001,DISP=(,PASS),SPACE=(TRK,(30,30))
//              DCB=(RECFM=VA,LRECL=137,BLKSIZE=141)
```

The FT06F001 card causes the information that is normally printed to be stored in a disk set. The DEDIN card points to the FT06F001 data set containing the desired output.

The DEDOUT card points to the specific printer (via the UNIT parameter) which is dedicated to the job. In this example,

*The graphics data sets are dummy or null data sets by default. The data sets are activated when the graphics option is invoked on the EXEC card (see Section 5.4.2).

the printer is 001; however, any available printer may be used. The DEDIN and DEDOUT DD cards are not part of the procedure and if used, they should be the last JCL cards in the deck.

5.3 UCLEG PROCEDURE

(The following text description of UCLEG has been left in the user's guide for those that may still need to use it. For the most part, GSFC has now installed GTDS source in a Panvalet environment. See Section 5.6.)

UCLEG is an acronym derived from the functions of the four steps within the procedure (i.e., update, compile, linkedit, and go). As noted previously, this procedure is designed for the user who wishes to modify one or more subroutines within GTDS. Each step of the procedure (shown in Figure 5-2) is discussed in detail in the remainder of Section 5.3. In addition, a short description on how to use the Compaction Utility program, PACKUPD, is included in the description of the update step.

The UCLEG procedure is slated for revision in the near future and will use Panvalet as the source compaction and maintenance utility. The current UCLEG procedure will be used until that is accomplished.

5.3.1 PUPAM AND PUPNZ STEPS

The update steps (PUPAM and PUPNZ) allow the user to perform temporary updates to any GTDS subroutine. Most JCL normally required is provided within the procedure step.

Two update steps are required because the GTDS source is now maintained in two libraries: one containing units with names beginning with the letters A through M, and the other with names beginning with the letters N through Z.

5.3.1.1 PUPAM and PUPNZ JCL

The first JCL card of PUPAM and PUPNZ is the EXEC card, which initiates execution of the update program, PACKUPD. This program resides in the data set defined by the second JCL card, STEPLIB. Thus, the STEPLIB card tells the operating system where to find PACKUPD. The third card, SYSPRINT, provides a vehicle for listing the PACKUPD input cards (and PACKUPD control cards) that designate the specific updates to be made. These control cards (see Section 5.3.1.2) must be included in a data set that is indirectly defined by the fourth JCL card, SYSIN. That is, the SYSIN DD card points to another DD card, DATAM or DATNZ, which actually defines the control card data set. For example, updates to the AM source would be provided as follows:

```
//PUPAM.DATAM  DD  *
  PACKUPD control card 1 \
          .              |
          .              } PACKUPD control cards for AM
          .              |  source units
  PACKUPD control card n /
```

The fifth and sixth cards (PACKIN and SEQOUT) define the input packed source data set and the sequential output containing the updated subroutines. Note that the output data set, SEQOUT, is a temporary data set that exists only for the job in which it is created. The last JCL card in the PDSUP step, SUBRLIST, optionally provides a printed list of the complete updated source subroutines, including the new card numbers which have been assigned as well as the card numbers as they appear in the permanent source library. If desired, this listing may be generated by including the parameter 'LIST' for the PUPAM or PUPNZ step on the EXEC UCLEG card, for example:

```
// EXEC UCLEG,PARM.PUPAM='LIST'
```

5.3.1.2 PACKUPD Control Cards

To generate the PACKUPD control cards previously mentioned, the user must have a current listing of the FORTRAN source code for each subroutine to be modified. The control cards used by the PACKUPD Program must conform to the following rules:

- A control card with a dollar sign ($) in card column 1 followed immediately by a subroutine name indicates to the PACKUPD Program which subroutine is to be updated.
- A minus sign (-) in card column 1, followed by a single line number, denotes an insertion of new source code following that line. The source code to be inserted must immediately follow this minus card.
- A minus sign (-) in card column 1, followed by a single line number, a comma, and a second single line number, denotes deletion of source code having line numbers from the first line number and continuing through the second line number. The user may optionally replace deleted source code with new source code included on cards which immediately follow this minus card.
- All line numbers associated with each subroutine must be in ascending order. Subroutines may be in any order.

The use of PACKUPD control cards is shown in the following example:

```
$EXAMPLE
-100
C  THESE CARDS ARE INSERTED
C  FOLLOWING CARD 100
-115,115
```

```
C  THESE TWO CARDS REPLACE
C  CARD NUMBER 115
-120,125
C  THIS CARD REPLACES CARDS 120 THRU 125
-130,136
-140,140
C  THIS CARD REPLACES CARD 140
```

The $EXAMPLE card indicates that subroutine EXAMPLE is to be updated. The -100 card indicates that all input cards up to the next minus card (in this case two comment cards) will be inserted into the EXAMPLE subroutine following line number 100. The -115,115 card indicates that line 115 will be deleted and replaced by all the input cards up to the next minus (again two comment cards). The -120,125 card indicates that cards with line numbers 120 through 125, inclusive, will similarly be replaced by the comment card, and the -130,136 card in the example deletes lines 130 through 136, inclusive, from the source code. The -140,140 card causes replacement of the line numbred 140 with the comment card.

Any number of these sets of control cards may be stacked one behind the other. No blank cards are allowed.

If an entire subroutine is to be added, the following control cards care needed:

```
$NEWSUB,ADD
      SUBROUTINE NEWSUB  )
               .         |
               .         }  source statements
               .         |
      END                )
```

5.3.2 SOURCE STEP

The compile step, SOURCE, receives as input the sequential output (SEQOUT) data set created by PACKUPD. It compiles all source code in the data set and creates a sequential output file containing the object modules for all subroutines involved. Normally, no user-supplied JCL is required for this step.

The EXEC card (card number 15 in Figure 5-2) initiates the FORTRAN H Extended (Enhanced) compiler. (GTDS uses a default optimization level of 3.) The second card of the source step, STEPLIB, points to the data set containing the FORTRAN compiler. The third card, SYSINDEX, assigns the printer as the output device for the subroutine index. The next JCL card of the source step, SYSLIN, defines the output object file. The SYSTERM data set is used by the operating system in case of job failure. The SYSPRINT and SYSPUNCH files are for printed and punched output, respectively. The printed output includes the source listing, XREF, MAP, etc. The punched output includes object decks. The SYSUT1, SYSUT2, and SYSUT3 cards define necessary work space for the compiler. The final JCL card of the source step, SYSIN, points to the input source data set (i.e., the SEQOUT data set that was created in the PDSUP step).

5.3.3 LINK STEP

The third step, LINK, combines the object modules created in the SOURCE step, additional object modules, system data sets, the current GTDS load module, and an overlay data set to create a temporary load module containing all user-specified modifications to the system. This combining operation is performed by the linkage editor program invoked on the EXEC card (card number 29 in Figure 5-2). The second JCL

card of the step, STEPLIB, points to the data set containing the linkage-editor. The next JCL card of the step, SYSLIB, points to the GTDS load module and various system libraries. The SYSLMOD data set contains the output load module. SYSLMOD is a temporary data set and is deleted at the end of the job unless an override is included to save or catalog the data set. The SYSPRINT and SYSUT1 cards provide printed output and internal work space for the linkage editor, and SYSUDUMP provides a dump area that will be used in case an abnormal termination occurs in this step. The TAPELIB data set is normally a dummy but may be overridden to include object modules from other input sources. The remaining linkage editor input comes from the SYSLIN data set (a concatenation of the object modules output from the compiler) plus the OVERLAY data set, which is defined via linkage editor input cards.

5.3.4 GO STEP

The GO step causes the actual execution of the load module created by the LINK step. The only difference between the GO step in the UCLEG procedure and the GO step in the GTDS procedure (see Section 5.2.2) is the load module that is executed. The GTDS procedure points to the operational version of GTDS for its load module, and UCLEG points to a modified GTDS version defined by the SYSLMOD DD card in the LINK step. All other JCL cards in the two GO steps are exactly the same as those described in Section 5.2.2.

5.4 PROCEDURE PARAMETERS

Whether the GTDS or the UCLEG procedure is used, several parameters may be required on the user-supplied EXEC card. These parameters are described in the remainder of this section.

5.4.1 REGION PARAMETER

The REGION parameter indicates what the core requirements are expected to be. There is a REGION parameter associated with each step of each procedure. The default REGION parameters are generally sufficient for most jobs, but at times the region size must be increased. This is true for all graphics jobs and for some jobs that use modified GTDS load modules.

The GO steps of both procedures default to a region size of 620K. Whenever GTDS is run in the interactive mode, using the IBM 2250 graphics terminals, the region size must be increased to 750K to allow for additional buffer space and for the graphics software linked to the standard load module. The region size may be increased as follows:

```
// EXEC GTDS,REGION.GO=1000K
            or
// EXEC UCLEG,REGION.GO=1000K
            or
// EXEC GTDSMOD,REGION.GO=1200K
```

for the GTDS and UCLEG and GTDSMOD procedures, respectively.

5.4.2 GRAPH AND UNIT PARAMETERS

In both the GTDS and the UCLEG procedures, two other parameters appear on the PROC statement, which is the first card in each figure. These parameters, GRAPH and UNIT, are both related to interactive mode options of GTDS.

The GRAPH parameter is used to place a job into the interactive mode. By coding GRAPH= on the procedure EXEC card, all data sets that are required for a graphics job are automatically allocated. This does not include the optional

data sets such as INPUTPDS. The EXEC card is coded as follows:

```
// EXEC GTDS,REGION.GO=1000K,GRAPH=
            or
// EXEC UCLEG,REGION.GO=1000K,GRAPH=
            or
// EXEC GTDSMOD,GRAPH=
```

The UNIT parameter allows the user to select the exact graphics device to be allocated to the job. In the procedure, the value of UNIT defaults to 2250-1. This tells OS/VS2 to assign an available IBM 2250 graphics device to the job.

When a specific device is selected through the UNIT symbolic parameter, care must be taken to ensure that the requested device is available (see Reference 3).

5.4.3 SSAM, SSN, MODULE, AND OVRLY PARAMETERS

In the UCLEG procedure, the SORS parameter defines the input partitioned data set containing the GTDS source library on the PACKIN card of the PDSUP step (see Section 5.3.1.1). The MODULE parameter defines the GTDS load module for the linkage-editor on the SYSLIB card of the LINK step (see Section 5.3.3). The OVRLY parameter defines the GTDS overlay data set for the linkage-editor on the SYSLIN card of the LINK step. The default data sets for these parameters are

```
SSAM='ORBIT.GTDS.SORSLIB.AMFORT',
SSNZ='ORBIT.GTDS.SORSLIB.NZ.FORT',
MODULE='ORBIT.GTDS.LOADMOD.LOAD',
OVRLY='ORBIT.GTDS.OVERLAY.DATA'
```

on the FDF R1 and R2 computers. To use data sets other than the default data sets, the user should either override the

proper DD cards in each job step or input the desired data sets through these parameters on the EXEC UCLEG card, as shown in the following example:

```
// EXEC UCLEG,
// SSAM='ORBIT.DELMOD.AMFORT',
// SSNZ='ORBIT.DELMOD.NZ.FORT',
// MODULE='ORBIT.DELMOD.LOAD',
// OVRLY='ORBIT.DELMOD.OVERLAY.DATA'
```

5.5 COM INDEXING

5.5.1 INTRODUCTION

Computer Output Microfiche (COM) with indexing can be invoked rather easily in either a GTDS DC Program or EPHEM Program. The major changes will occur in the JCL of the COM procedure and will be explained in detail later. The indexing will include the titles and grid locations (page numbers) of all the major reports in a DC or EPHEM Program, along with a detailed index for each SOR batch report. Indexing will work for all tracker types. The indexed frames will appear as the last two frames reproduced on the microfiche.

5.5.2 REQUIREMENTS TO IMPLEMENT COM INDEXING

No changes to GTDS are required to implement COM indexing. However, two JCL card changes are required to invoke COM indexing. Figure 5-3 shows the JCL presently needed to run the COM procedure, including the output file card FT06. If COM indexing is desired, then the EXEC card must contain the parameter data set name INDEX located in the partitioned data set specified by the data definition card EZFPARMS. Stating it another way, this means that program SEQ is located in data set SYS2.COMPARM and that program INDEX is located in data set ORBIT.COMPARM.DATA.

5.5.3 DESCRIPTION OF COM INDEXING ROUTINE

Microfiche indexing can be invoked from the COM procedure by either calling the existing indexing routine (INDEX) or providing your own input parameter setup using the EZFPARMS data definition card. A sample setup is shown in Figure 5-4. All these cards are required for microfiche. However, only the INDXPG, INDXHDR, and INDEX keywords are used for the indexing step. (All parameters are described in Reference 15.)

The INDXPG parameter card must be specified according to the desired indexed output. The first field, enclosed in a separate set of parenthesis, specifies the maximum index key length, print start position, and the print length. The maximum key length is 127 characters or less, and the print length is determined by the number of columns specified in the second field. If one column per index frame is requested, then the maximum print length is 108. If n columns is specified, then the print length must be approximately equal to or less than 127/n depending upon room for grid locators and spacing between columns. The other fields in the INDXPG keyword as well as the INDXHDR and INDEX keywords are explained in Reference 15. It should be noted that on the INDEX card the mask field tested may be longer or shorter than the field actually specified by the position parameter.

The other COM parameters are explained in detail in Reference 15.

5.5.4 SUMMARY

COM indexing can be implemented by the GTDS user with only slight changes to his or her existing card decks.

5.6 UPDATING GTDS IN A PANVALET ENVIRONMENT

5.6.1 INTRODUCTION

The vast size of GTDS makes the cataloging and storage of a GTDS load module undesirable. A programmer often must debug to understand the program flow in GTDS. Many runs are often necessary for the testing of possible solutions and verification that some solution does not interfere with usual GTDS results. Each run involves different updates and, therefore, the GTDS load module created in one of these runs should not be kept after the completion of the batch run. Procedures for modifying GTDS have been written that delete the load module at the end of the job.

5.6.2 GTDSMOD AND THE STANDARD PROCEDURAL LIBRARY

Creating a test GTDS load module usually involves executing several steps contained in a cataloged procedure called GTDSMOD. This procedure exists in several procedural libraries, but is maintained and kept most up to date in the maintenance library. It is urged that GTDSMOD from TCSXX. MAINT.NEW.PROCLIB be used unless special circumstances arise that warrant usage of some other procedure and, in such cases, extreme caution should be taken in their use. It is difficult to merge many updates from many different programmers because conflicts are usual; different procedures can make these conflicts and problems impossible to resolve. Also, other procedures lack checks that protect the configured source from accidental changes.

The steps in the GTDSMOD procedure are as follows:

- CHECK--Gathers user updates; consists of Panvalet commands, source updates; input is mandatory. Checks Panvalet commands in INMOD step to make sure

source or Panvalet library will not be altered permanently; leaves incorrect Panvalet usage to the next step but will abort job if user is about to alter configured library.

- MODUPD--Applies temporary updates to configured Panvalet source library.
- SOURCE--Compiles the subroutines passed from MODUPD above.
- LINK--Links compiled units with load module that matches configured source library and creates a temporary load module; uses configured overlay or one created by user.
- GO--Executes temporary load module created in LINK; deleted at end of job.

GTDSMOD is provided in Figure 5-5 for easy reference.

5.6.3 SAMPLE JOB SETUP

A sample GTDSMOD execution appears in its simplest form as:

```
//ZBXXXMOD JOB (BTCOP,MMDM,NN),'GTDSMOD SPLT ',TIME=3
//  MSGLEVEL=(1,1),MSGCLASS=X,CLASS=B,NOTIFY=ZBXXX
/*JOBPARM LINECT=88,LINES=50
//PROCLIB DD DSN=TCSXX.MAINT.NEW.PROCLIB,DISP=SHR
// EXEC VGTDSMOD
//INMOD.DATA5 DD *
++UPDATE RUNACC,1,TEMP
++C 3,3
C     SEE LINE DELETED--SEE
C                               THESE
C                                     IN ITS PLACE
++C 4
C     SEE THIS ADDITIONAL LINE
++WRITE WORK,RUNACC
++WRITE PRINT,RUNACC
/*
//GO.FT24F001 DD DSN=&EPH1,UNIT=3350,DISP=(,PASS),
//    SPACE=(TRK,(10,2),RLSE)
//GO.FT80F001 DD DSN=&&TARGET
//GO.FT97F001 DD DSN=&&RELAY1
//GO.DATA5    DD *
```

```
CONTROL   EPHEM                                           LNDSAT-4    8
EPOCH                   840521.0
ELEMENT1   1   1   1    -6439.7           -2763.1         1045.6
ELEMENT2                -1.4203           0.55137         7.3449
ORBTYPE    2   1   1    180.0
OUTPUT     2   2   1    840522.0          040000.0        7200.0
OGOPT
OUTOPT    23   1   2    840520170000.0   840522040000.0
END
FIN
/*
//
```

Note that the JOBPARM with LINECT = 88 is necessary. Note also that GTDS usually outputs more than the default 20K lines, so lines = 50 is recommended. Time = 3, class = B is also recommended for most jobs.

5.6.4 PANVALET UPDATES

All GTDS source, including a copy of the overlay, is maintained in a configured Panvalet library. Under no circumstances should this source be accessed with an ISPF Panvalet edit option. It may be ISPF Panvalet browsed, but blue books with line numbers are readily available so usually browsing is not necessary.

Only certain Panvalet options can be applied temporarily; the default is permanent. Thus, only certain Panvalet options are allowed in GTDSMOD (see check step). These options are illustrated below.

1. ++UPDATE RUNACC,1,TEMP--RUNACC is a level 1 (see blue book level numbers) and updates will be temporary. 'TEMP' must be specified or the job will abort (check). An incorrect level number will cause Panvalet error and job termination.

2. Line numbers accessing a unit must be in ascending order.

3. Failure to '++WRITE WORK' will result in discounting updates, with no error messages; the updated units will not be compiled.

```
MEMBER=VGTDSDEL

//****   VSFORTRAN DEL PROC
//*********************************************************************
//**      JCL PROCEDURE FOR THE GTDS PROGRAM - VSFORTRAN
//**               TCOPS RELEASE 3
//**
//**  D. SQUIER (CSC) 4/87
//**
//**
//**
//*********************************************************************
//**
//VGTDSDEL PROC PRF=ORBIT,OUT='*',
//              MEM=GTDS,
//              DELTA='ZBCQP.GTDS30.LOAD1023',
//              CODE1=9,CODE2=LT,REG=2000K,
//              GRAPH='DUMMY,',UNIT='2250-1',
//              B=5,G=1,DSK=SYSDA,DSK1=SYSDA,
//              TAPE=SYSDA,
//              GTDPBF=NULLFILE,
//              GTPBRF=NULLFILE,
//              SOREXT=,
//              DBM60='TCSXX.MAINT.G2DJC.DBM60'
//*
//*
//*******************************************************************
//*          PROCEDURE SYMBOLIC PARAMETERS                           *
//*******************************************************************
//*                                                                  *
//*                                                                  *
//* NAME     FRN   DESCRIPTION                                       *
//* ------   ---   --------------------------------------------------*
//* DELTA          DATASET NAME FOR GTDS DELMOD EXECUTABLE           *
//* MEM            GTDS MEMBER-NAME IN GTDS LOAD LIB                 *
//* REG            REGION SIZE FOR GTDS                              *

 05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB
```

Figure 5-1. Listing of the Procedure: GTDS (1 of 6)

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

```
//* OUT              SYSOUT CLASS FOR FT06 OUTPUT                        *
//* DSK              UNIT NAME FOR DISK                                  *
//* PRF              ORBIT DATASET NAME PREFIX                           *
//* CODE1            GO STEP COND CODE TEST PARAM                        *
//* CODE2            GO STEP COND CODE TEST PARAM                        *
//* GRAPH            PARAMETER TO NULL GRAPHICS DATASETS                 *
//* UNIT             UNIT NAME FOR 2250 GRAPHICS TERMINAL                *
//* B                BUFNO FOR GTDS DATASETS                             *
//* G                BUFNO FOR GTDS GRAPHICS DATASETS                    *
//* TAPE             UNIT NAME FOR 1600-BPI TAPE                         *
//* GTDPBF     32    DATASET NAME FOR 60-BYTE PARTIAL-BATCH FILE         *
//* GTPBRF     56    DATASET NAME FOR PARTIAL-BATCH REQUEST FILE         *
//* SOREXT     64    TAPE VOL-SER FOR SOR EXTRACT FILE                   *
//* DBM60      96    DATASET NAME FOR 60-BYTE DATA BASE                  *
//*                                                                      *
//***********************************************************************
//*
//*
//*
//GO   EXEC    PGM=&MEM,COND=(&CODE1,&CODE2),REGION=&REG
//STEPLIB  DD DSN=&DELTA,DISP=SHR
//FT00F001 DD DUMMY
//FT01F001 DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=133)
//FT02F001 DD DISP=SHR,DSN=&PRF..GTDS.ATMOSDEN.DATA,DCB=BUFNO=&B
//FT03F001 DD DISP=SHR,DSN=&PRF..GTDS.MANEUVER.DATA,DCB=BUFNO=&B
//FT04F001 DD DISP=SHR,DSN=&PRF..GTDS.ASTROCON.DATA,DCB=BUFNO=&B
//FT05F001 DD DDNAME=DATA5
//*    FOR COM STEP CHOOSE BLKSIZE=6118
//FT06F001 DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=133)
//FT07F001 DD SYSOUT=&OUT,DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//FT08F001 DD DISP=SHR,DSN=&PRF..GTDS.EARTHFLD.DATA,DCB=BUFNO=&B
//FT09F001 DD DISP=SHR,DSN=&PRF..GTDS.LUNARFLD.DATA,DCB=BUFNO=&B
//FT10F001 DD DISP=SHR,DSN=&PRF..GTDS.INTCOEF.DATA,DCB=BUFNO=&B
//FT11F001 DD DISP=SHR,DSN=&PRF..GTDS.SECTIONS.DATA,DCB=BUFNO=&B
//FT12F001 DD &GRAPH.UNIT=&DSK,    TEMPORARY DATA FOR CRT INPUT MODE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             DISP=(NEW,DELETE),SPACE=(TRK,(1,1)),DSN=&&INPROMPT
//FT13F001 DD DISP=SHR,DSN=TCSXX.GTDS.ERRORMSG.DATA,DCB=BUFNO=1
//FT14F001 DD DISP=SHR,DSN=&PRF..GTDS.SLP1950.DATA,
//             LABEL=(,,,IN),DCB=BUFNO=&B
//FT15F001 DD DDNAME=OBSCARDS        OBSERVATION CARDS
//FT16F001 DD DSN=&F16,              DATA SIMULATION SUMMARY WORKING FILE
//             UNIT=&DSK,SPACE=(124,700),DCB=(DSORG=DA,BUFNO=&B)
//FT17F001 DD DSN=&F17,              OBSERVATIONS WORKING FILE
//             UNIT=&DSK1,
//             DCB=(RECFM=FB,LRECL=184,BLKSIZE=6072,BUFNO=&B),
//             SPACE=(6072,(100,40),,,ROUND)
//FT18F001 DD DSN=&F18,              SLP WORKING FILE
//             UNIT=&DSK,SPACE=(2264,48),DCB=(DSORG=DA,BUFNO=&B)
//FT19F001 DD DSN=&F19,              DISK ORBIT FILE WITH PARTIALS
//             DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//             UNIT=&DSK,SPACE=(1024,1500)
//FT20F001 DD DSN=&&F20,             DISK ORBIT FILE WITHOUT PARTIALS
//             UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
```

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

Figure 5-1. Listing of the Procedure: GTDS (2 of 6)

```
//              SPACE=(1024,500)
//FT21F001 DD DSN=&&F21,          TAPE ORBIT FILE WITH PARTIALS
//              DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT22F001 DD DSN=&&F22,          TAPE ORBIT FILE WITHOUT PARTIALS
//              DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT23F001 DD &GRAPH.UNIT=&DSK,   ERROR MESSAGES FOR SCOPE
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//              SPACE=(TRK,(1,10)),DISP=(,PASS)
//FT24F001 DD DSN=&F24,           1ST ORB1 OR EPHEM OUTPUT FILE
//              UNIT=&DSK,DISP=(,PASS),
//              DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B),
//              SPACE=(TRK,(1,10))
//FT25F001 DD DISP=SHR,DSN=&PRF..GTDS.ELEMENTS.DATA,DCB=BUFNO=&B
//FT26F001 DD DSN=TCSXX.MAINT.TVHF.DATA,DISP=SHR  TCOPS VECTOR H. F.
//FT27F001 DD DISP=SHR,DSN=&PRF..GTDS.GEODTICS.DATA,DCB=BUFNO=&B
//FT28F001 DD &GRAPH.UNIT=&DSK,   SATELLITE EPHEMERIS TO SCOPE
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//              SPACE=(TRK,(1,10))
//FT29F001 DD DSN=&&F29,          GTDS OBSERVATION TAPE FILE
//              DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),SPACE=(TRK,(1,10))
//FT30F001 DD DSN=&&F30,          DODS OBSERVATION TAPE
//              DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),SPACE=(TRK,(1,10))
//FT31F001 DD DSN=&&F31,          GTDS OBSERVATION DISK FILE
//              UNIT=&DSK,DISP=(,PASS),
//              DCB=(RECFM=F,BLKSIZE=7200),
//              SPACE=(TRK,(2,10),RLSE)
//FT32F001 DD DSN=&GTDPBF,        60-BYTE PARTIAL BATCH FILE
//              DISP=SHR
//FT33F001 DD DSN=&&F33,          SLP TAPE
//              DCB=(RECFM=VS,BLKSIZE=3460,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT34F001 DD DSN=&&F34,          JPL TAPE
//              DCB=(RECFM=VBS,LRECL=8304,BLKSIZE=8308,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP,,IN),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT35F001 DD &GRAPH.UNIT=&DSK,   INTEGRATION STATISTICS FOR SCOPE
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//              SPACE=(TRK,(1,10))
//FT36F001 DD &GRAPH.UNIT=&DSK,   FINAL ORBIT GENERATOR DISPLAY FOR SCOP
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//              SPACE=(TRK,(1,10))
//FT37F001 DD DSN=&F37,           OBSERVATIONS SORT FILE
//              UNIT=&DSK,
//              DCB=(RECFM=VBS,LRECL=188,BLKSIZE=6208,BUFNO=&B),
//              SPACE=(TRK,(20,10))
//FT38F001 DD DISP=SHR,DSN=&PRF..GTDS.TIMCOF.DATA,DCB=BUFNO=&B
//FT39F001 DD DISP=SHR,DSN=&PRF..GTDS.GENCOF.DATA,DCB=BUFNO=&B
```

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

Figure 5-1. Listing of the Procedure: GTDS (3 of 6)

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

```
//FT40F001 DD DUMMY                    PERMANENT FILES TO SCOPE
//FT41F001 DD DSN=&F41,                TEMPORARY STARTER ARRAYS
//             UNIT=&DSK,SPACE=(TRK,(1,10)),
//             DCB=(RECFM=VBS,LRECL=5796,BLKSIZE=5800,BUFNO=&B)
//FT42F001 DD &GRAPH.UNIT=&DSK,       OBSERVATION RESIDUALS FOR SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT43F001 DD &GRAPH.UNIT=&DSK,       SOLVE PARAMETERS FOR SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT44F001 DD &GRAPH.UNIT=&DSK,       ELEMENTS FOR SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT45F001 DD DSN=&F45,                SCRATCH ORBIT FILE
//             UNIT=&DSK,
//             DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,BUFNO=&B),
//             SPACE=(CYL,(5,1))
//FT46F001 DD DSN=&&F46,               OBSERVATION SAVE
//             DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=&B)
//             UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),SPACE=(TRK,(1,10)
//FT47F001 DD SYSOUT=*,                URC PUNCH FILE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=80)
//FT48F001 DD DSN=&&F48,               EARTH/LUNAR POT FIELD WORKING FILE
//             UNIT=&DSK,SPACE=(4200,2),DCB=(DSORG=DA,BUFNO=&B),
//             DISP=(,PASS)
//FT49F001 DD &GRAPH.UNIT=&DSK,       D. C. SUMMARY REPORT FOR SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT50F001 DD DDNAME=DODSUM            TRACKING DATA ACQUISITION SUMMARY
//FT51F001 DD DUMMY,                   TELETYPE ELEMENTS REPORT
//             DCB=(RECFM=FBA,LRECL=80,BLKSIZE=800,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT52F001 DD DSN=&&F52,               DATA SIMULATION INPUT DODS TAPE
//             DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//             SPACE=(TRK,(1,10))
//FT53F001 DD DUMMY,                   CAIRS REPORT FILE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=800),UNIT=&DSK,DISP=SHR
//FT54F001 DD DSN=&&F54,               CHEBYSHEV EPHEMERIS FOR PDP-11
//             UNIT=&DSK,LABEL=(1,BLP),      UNIT=TAPEDEN2
//             DCB=(RECFM=FB,LRECL=316,BLKSIZE=316,DEN=2,BUFNO=&B),
//             SPACE=(TRK,(1,10))
//FT55F001 DD &GRAPH.UNIT=&UNIT        GRAPHICS DEVICE  (2250)
//*            DCB=GNCP=5
//FT56F001 DD DSN=&GTPBRF,             PARTIAL BATCH REQUEST FILE
//             DISP=SHR
//FT57F001 DD DSN=&F57,                SCRATCH AREA FOR COMMON
//             UNIT=&DSK,
//             SPACE=(TRK,(10,5)),DCB=BUFNO=&B
//FT58F001 DD DSN=&F58,                IONOSPHERE WORKING FILE
//             UNIT=&DSK,
//             SPACE=(1332,20),DCB=(DSORG=DA,BUFNO=&B)
//FT59F001 DD DISP=SHR,DSN=&PRF..GTDS.SOLDAT.DATA,DCB=BUFNO=&B
//FT60F001 DD DISP=SHR,DSN=&PRF..GTDS.ACCOUNT.DATA,DCB=BUFNO=&B
```

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

Figure 5-1. Listing of the Procedure: GTDS (4 of 6)

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

```
//FT61F001 DD DSN=&F61,UNIT=&DSK,     RESIDUAL EDIT WORKING FILE
//            DCB=(RECFM=VBS,LRECL=564,BLKSIZE=6208,BUFNO=&B),
//            SPACE=(CYL,(6,1))
//FT62F001 DD DUMMY,UNIT=&DSK,   RESIDUAL PLOT DATA FILE (DAIO)
//         DCB=(RECFM=FB,LRECL=160,BLKSIZE=3520,DSORG=DA),
//         DISP=(,PASS),SPACE=(TRK,(100,50),RLSE)
//FT63F001 DD DUMMY,              FLIGHT DIRECTOR'S REPORT
//            DCB=(DSORG=DA,BUFNO=&B)
//FT64F001 DD DSN=&&F64,          SOR EXTRACT FILE
//            DCB=(RECFM=VBS,LRECL=132,BLKSIZE=3304,DEN=3,BUFNO=&B),
//*           UNIT=(&TAPE,,DEFER),LABEL=(1,BLP),DISP=(,PASS),
//            UNIT=&DSK,DISP=(,PASS),SPACE=(TRK,(1,10)),
//            VOL=SER=&SOREXT
//FT65F001 DD DSN=&&F65,          IONOSPHERE WORKING FILE
//            UNIT=&DSK,DISP=(,PASS),
//            SPACE=(1176,62),DCB=(DSORG=DA,BUFNO=&B)
//FT66F001 DD DSN=&&F66,          IONSPHERIC SAVE FILE
//            DCB=(RECFM=VBS,LRECL=1180,BLKSIZE=1184,BUFNO=&B),
//            SPACE=(TRK,(3,1),RLSE),UNIT=&DSK
//FT67F001 DD DSN=&&F67,          REAL TIME IONOSPHERE DATA
//            UNIT=&DSK,SPACE=(1432,151),DCB=(DSORG=DA,BUFNO=&B),
//            DISP=(,PASS)
//FT68F001 DD DISP=SHR,DSN=&PRF..GTDS.TRODAT.DATA,DCB=BUFNO=&B
//FT69F001 DD &GRAPH.UNIT=&DSK,DISP=SHR,         PROMPTING
//            DSN=ORBIT.GTDS.PROMPT.DATA,DCB=(DSORG=DA,BUFNO=14)
//FT70F001 DD DUMMY               GRAPHICS CARD INPUT FILE
//FT71F001 DD DUMMY             PRE-GENERATED INPUT ORBIT FILE RELAY 1
//FT72F001 DD DUMMY             PRE-GENERATED INPUT ORBIT FILE RELAY 2
//FT73F001 DD DUMMY             PRE-GENERATED INPUT ORBIT FILE RELAY 3
//FT74F001 DD &GRAPH.UNIT=&DSK,   GRAPHICS INTERRUPT FILE
//            DCB=(RECFM=FB,LRECL=22,BLKSIZE=2200,BUFNO=&G),
//            SPACE=(TRK,(1,1)),DSN=&GRNTR
//FT75F001 DD DISP=SHR,DSN=&PRF..GTDS.JACCHIA.DATA,DCB=BUFNO=&B
//FT76F001 DD DSN=&F76,           GMAN OUTPUT FILE
//            UNIT=&DSK,
//            SPACE=(TRK,(1,10)),DISP=(,PASS),
//            DCB=(RECFM=VBS,BLKSIZE=8764,LRECL=1940)
//FT77F001 DD DSN=&F77,           EPHEM WORKING FILE
//            UNIT=&DSK,
//            SPACE=(2800,350),DCB=(RECFM=F,BLKSIZE=2800,BUFNO=&B)
//FT78F001 DD DISP=SHR,DSN=&PRF..GTDS.SLPTOD.DATA,DCB=BUFNO=&B
//FT79F001 DD DSN=TCSXX.FSF.DATA,DISP=SHR   FLIGHT SECTIONING FILE
//FT80F001 DD DUMMY,              TARGET SCRATCH ORBIT FILE
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//            SPACE=(CYL,(4,1)),UNIT=&DSK1
//FT81F001 DD DSN=&F81,           2ND ORB1 OR EPHEM OUTPUT FILE
//            UNIT=&DSK,
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT82F001 DD DSN=&&F82,          COMPARE SEQ ORBIT FILE 2, WITH PARTS
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//            SPACE=(TRK,(1,10))
//FT83F001 DD DSN=&&F83,          3RD ORB1 OR EPHEM OUTPUT FILE
//            UNIT=&DSK,DISP=(,PASS),
```

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

Figure 5-1. Listing of the Procedure: GTDS (5 of 6)

05NOV87 11.53.06 - VOL=VF1SC1, DSN=TCSXX.MAINT.NEWX.PROCLIB

```
//              SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT84F001 DD DSN=&&F84,           COMPARE SEQ ORBIT FILE 2, W/O PARTS
//              DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT85F001 DD DSN=&&F85,           4TH ORB1 OR EPHEM OUTPUT FILE
//              UNIT=&DSK,DISP=(,PASS),
//              SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT86F001 DD DSN=&&F86,           COMPARE DA ORBIT FILE 2, WITH PARTS
//              UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//              SPACE=(1024,1500),DISP=(,PASS)
//FT87F001 DD DSN=&&F87,           5TH ORB1 OR EPHEM OUTPUT FILE
//              UNIT=&DSK,DISP=(,PASS),
//              SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT88F001 DD DSN=&&F88,           COMPARE DA ORBIT FILE 2, W/O PARTIALS
//              UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//              SPACE=(1024,500)
//FT91F001 DD DSN=&&F91,           USB OBSERVATIONS (60-BYTE)
//              UNIT=&DSK,DCB=(RECFM=VBS,LRECL=64,BLKSIZE=6404,BUFNO=&B),
//              DISP=(,PASS),SPACE=(TRK,(1,10))
//FT92F001 DD DSN=&F92,            ERROR ANALYSIS SUMMARY FILE
//              UNIT=&DSK,SPACE=(6220,(6,3)),
//              DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=&B)
//FT93F001 DD DSN=&F93,            ERROR ANALYSIS WORKING FILE
//              UNIT=&DSK,SPACE=(6220,(6,3)),
//              DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=&B)
//FT94F001 DD DSN=&&F94,           OPTICAL ASPECT DATA
//              DCB=(RECFM=VBS,LRECL=28,BLKSIZE=564,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT95F001 DD DSN=&F95,            STATISTICAL OUTPUT REPORT FILE
//              UNIT=&DSK1,SPACE=(CYL,(4,1)),
//              DCB=(RECFM=FB,LRECL=160,BLKSIZE=9440,BUFNO=&B)
//FT96F001 DD DSN=&DBM60,          60-BYTE DATA BASE
//              DCB=BUFNO=&B,DISP=SHR
//FT97F001 DD DUMMY,               RELAY 1 SCRATCH ORBIT FILE
//              DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//              SPACE=(CYL,(4,1)),UNIT=&DSK1
//FT98F001 DD DUMMY,               RELAY 2 SCRATCH ORBIT FILE
//              DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//              SPACE=(TRK,(10,2)),UNIT=&DSK1
//FT99F001 DD DUMMY,               RELAY 3 SCRATCH ORBIT FILE
//              DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//              SPACE=(TRK,(10,2)),UNIT=&DSK1
//INPUTPDS DD DUMMY,               CRT INPUT
//              UNIT=&DSK,DISP=SHR,
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=7200)
//NUCLEUS  DD DISP=SHR,VOL=REF=SYS1.SVCLIB,DCB=BUFNO=1
//SYSUDUMP DD SYSOUT=&OUT,OUTLIM=2000
//ERRDUMP  DD &GRAPH.SYSOUT=&OUT
//*
//*
//*
```

Figure 5-1. Listing of the Procedure: GTDS (6 of 6)

```
//*
//UCLEG PROC GRAPH='DUMMY,',UNIT='2250-1',PRF=ORBIT,
//          B=5,G=1,DSK=3350,DSK1=3350,
//          TAPE=TAPEDEN3,
//          SOREXT=,
//          OUT='*',
//          SSAM='ORBIT.GTDS.SORSLIB.AM.FORT',
//          SSNZ='ORBIT.GTDS.SORSLIB.NZ.FORT',
//          MODULE='ORBIT.GTDS.LOADMOD.LOAD',
//          OVRLY='ORBIT.GTDS.OVERLAY.DATA',
//          FORT='Q',SRC=SOURCE,XR=XREF,TRM=TERM,LC=78,    COMPILER OPTS
//          LST=NOLIST,MAP=NOMAP,OV=OVLY                  LINK-EDIT OPTS
//PUPAM   EXEC PGM=PACKUPD,REGION=180K
//STEPLIB  DD DISP=SHR,DSN=&PRF..PACK.LOAD
//SYSPRINT DD SYSOUT=&OUT
//SYSIN    DD DDNAME=DATAM
//PACKIN   DD DSN=&SSAM,DISP=SHR
//SEQOUT   DD DSN=&SCR,UNIT=&DSK,SPACE=(TRK,(20,10)),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),DISP=(MOD,PASS)
//SUBRLIST DD SYSOUT=&OUT
//PUPNZ   EXEC PGM=PACKUPD,REGION=180K
//STEPLIB  DD DISP=SHR,DSN=&PRF..PACK.LOAD
//SYSPRINT DD SYSOUT=&OUT
//SYSIN    DD DDNAME=DATNZ
//PACKIN   DD DSN=&SSNZ,DISP=SHR
//SEQOUT   DD DSN=&SCR,UNIT=&DSK,SPACE=(TRK,(20,10)),
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),DISP=(MOD,PASS)
//SUBRLIST DD SYSOUT=&OUT
//SOURCE EXEC PGM=FORT&FORT,PARM='&SRC,&XR,&TRM,OPT(3),LC(&LC),XL',
//          REGION=600K
//SYSLIN   DD DSN=&&OBJMOD,UNIT=&DSK,SPACE=(TRK,(10,10)),
//          DISP=(MOD,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSTERM  DD SYSOUT=&OUT
//SYSPRINT DD SYSOUT=&OUT
//SYSPUNCH DD SYSOUT=Z
//SYSUT1   DD UNIT=&DSK,SPACE=(TRK,(10,10))
//SYSUT2   DD UNIT=&DSK,SPACE=(TRK,(10,10))
//SYSUT3   DD UNIT=DISK,SPACE=(TRK,(10,10))
//SYSIN    DD DSN=&SCR,UNIT=&DSK,DISP=(OLD,DELETE)
//LINK EXEC PGM=IEWL,PARM='LET,&LST,&MAP,&OV,SIZE=(600K,52K)',
//          COND=(5,LT),REGION=660K
//STEPLIB  DD DSN=&PRF..HEWLLIB,DISP=SHR
//SYSLIB   DD DSN=SYS0.LKEDLIB,DISP=SHR
//         DD DSN=SYS0.LKEDLIB,DISP=SHR
//         DD DSN=&MODULE,DISP=SHR
//         DD DSN=SYS2.FORT&FORT.LIB,DISP=SHR
//         DD DSN=SYS2.LKEDLIB,DISP=SHR
//         DD DSN=SYS3.LKEDLIB,DISP=SHR
//         DD DSN=SYS2.PL1FLIB,DISP=SHR
//SYSLMOD  DD DSN=&&LODMOD(GTDSTEMP),DISP=(,PASS),
//             SPACE=(TRK,(300,10,1),RLSE),UNIT=&DSK
//SYSPRINT DD SYSOUT=&OUT
//SYSUT1   DD UNIT=&DSK,SPACE=(TRK,(300,30))
//SYSUDUMP DD SYSOUT=&OUT
//TAPELIB  DD DUMMY,DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSLIN   DD DSN=&&OBJMOD,DISP=(OLD,DELETE),DCB=RECFM=FB
//         DD DSN=&OVRLY,DISP=SHR
//GO EXEC  PGM=*.LINK.SYSLMOD,COND=((5,LT,SOURCE),EVEN),REGION=1000K
//FT01F001 DD SYSOUT=&OUT,
//             DCB=(RECFM=FBA,LRECL=133,BLKSIZE=19019,BUFNO=1)
```

Figure 5-2. Listing of the Procedure: UCLEG (1 of 5)

```
//FT02F001 DD DISP=SHR,DSN=&PRF..GTDS.ATMOSDEN.DATA,DCB=BUFNO=&B
//FT03F001 DD DISP=SHR,DSN=&PRF..GTDS.MANEUVER.DATA,DCB=BUFNO=&B
//FT04F001 DD DISP=SHR,DSN=&PRF..GTDS.ASTROCON.DATA,DCB=BUFNO=&B
//FT05F001 DD DDNAME=DATA5
//FT06F001 DD SYSOUT=&OUT,
//             DCB=(RECFM=FBA,LRECL=133,BLKSIZE=19019,BUFNO=&B)
//FT07F001 DD DUMMY,DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160,BUFNO=&B)
//FT08F001 DD DISP=SHR,DSN=&PRF..GTDS.EARTHFLD.DATA,DCB=BUFNO=&B
//FT09F001 DD DISP=SHR,DSN=&PRF..GTDS.LUNARFLD.DATA,DCB=BUFNO=&B
//FT10F001 DD DISP=SHR,DSN=&PRF..GTDS.INTCOEF.DATA,DCB=BUFNO=&B
//FT11F001 DD DISP=SHR,DSN=&PRF..GTDS.SECTIONS.DATA,DCB=BUFNO=&B
//FT12F001 DD &GRAPH.UNIT=&DSK,   TEMPORARY DATA FOR CRT INPUT MODE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             DISP=(NEW,DELETE),SPACE=(TRK,(1,1)),DSN=&&INPROMPT
//FT13F001 DD DISP=SHR,DSN=&PRF..GTDS.ERRORMSG.DATA,DCB=BUFNO=1
//FT14F001 DD DISP=SHR,DSN=&PRF..GTDS.SLP1950.DATA,
//             LABEL=(,,,IN),DCB=BUFNO=&B
//FT15F001 DD DDNAME=OBSCARDS      OBSERVATION CARDS
//FT16F001 DD DSN=&F16,            DATA SIMULATION SUMMARY WORKING FILE
//             UNIT=&DSK,SPACE=(124,(700,700)),DCB=(DSORG=DA,BUFNO=&B)
//FT17F001 DD DSN=&F17,            OBSERVATIONS WORKING FILE
//             UNIT=&DSK1,
//             DCB=(RECFM=FB,LRECL=184,BLKSIZE=6072,BUFNO=&B),
//             SPACE=(6072,(100,40))
//FT18F001 DD DSN=&F18,            SLP WORKING FILE
//             UNIT=&DSK,SPACE=(2264,48),DCB=(DSORG=DA,BUFNO=&B)
//FT19F001 DD DSN=&F19,            DISK ORBIT FILE WITH PARTIALS
//             DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//             UNIT=&DSK,SPACE=(1024,1500)
//FT20F001 DD DUMMY,               DISK ORBIT FILE WITHOUT PARTIALS
//             UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//             SPACE=(1024,500)
//FT21F001 DD DUMMY,               TAPE ORBIT FILE WITH PARTIALS
//             DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT22F001 DD DUMMY,               TAPE ORBIT FILE WITHOUT PARTIALS
//             DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT23F001 DD &GRAPH.UNIT=&DSK,    ERROR MESSAGES FOR SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT24F001 DD DSN=&F24,            1ST ORB1 OR EPHEM OUTPUT FILE
//             UNIT=&DSK,
//             DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B),
//             SPACE=(TRK,(1,10))
//FT25F001 DD DISP=SHR,DSN=&PRF..GTDS.ELEMENTS.DATA,DCB=BUFNO=&B
//FT26F001 DD DISP=SHR,DSN=&PRF..GTDS.D24HOUR.DATA,DCB=BUFNO=&B
//FT27F001 DD DISP=SHR,DSN=&PRF..GTDS.GEODTICS.DATA,DCB=BUFNO=&B
//FT28F001 DD &GRAPH.UNIT=&DSK,    SATELLITE EPHEMERIS TO SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT29F001 DD DUMMY,               GTDS OBSERVATION TAPE FILE
//             DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT30F001 DD DUMMY,               DODS OBSERVATION TAPE
//             DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT31F001 DD DUMMY,               GTDS OBSERVATION DISK FILE
//             UNIT=&DSK,DISP=SHR
//FT32F001 DD DUMMY,DISP=SHR       60-BYTE PARTIAL BATCH FILE
//FT33F001 DD DUMMY,               SLP TAPE
//             DCB=(RECFM=VS,BLKSIZE=3460,DEN=3,BUFNO=&B),
```

Figure 5-2. Listing of the Procedure: UCLEG (2 of 5)

```
//                UNIT=&TAPE,LABEL=(,BLP),DISP=SHR                                00000710
//FT34F001 DD DUMMY,                JPL TAPE                                      00000720
//                DCB=(RECFM=VBS,LRECL=8304,BLKSIZE=8308,DEN=3,BUFNO=&B),         00000730
//                UNIT=&TAPE,LABEL=(,BLP,,IN),DISP=SHR                            00000740
//FT35F001 DD &GRAPH,UNIT=&DSK,     INTEGRATION STATISTICS FOR SCOPE              00000750
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),                  00000760
//                SPACE=(TRK,(1,10))                                              00000770
//FT36F001 DD &GRAPH,UNIT=&DSK,     FINAL ORBIT GENERATOR DISPLAY FOR SCOP00000780
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),                  00000790
//                SPACE=(TRK,(1,10))                                              00000800
//FT37F001 DD DSN=&F37,             OBSERVATIONS SORT FILE                        00000810
//                UNIT=&DSK,                                                      00000811
//                DCB=(RECFM=VBS,LRECL=188,BLKSIZE=6208,BUFNO=&B),                00000820
//                SPACE=(TRK,(20,10))                                             00000830
//FT38F001 DD DISP=SHR,DSN=&PRF..GTDS.TIMCOF.DATA,DCB=BUFNO=&B                    00000840
//FT39F001 DD DISP=SHR,DSN=&PRF..GTDS.GENCOF.DATA,DCB=BUFNO=&B                    00000850
//FT40F001 DD DUMMY                 PERMANENT FILES TO SCOPE                      00000860
//FT41F001 DD DSN=&F41,             TEMPORARY STARTER ARRAYS                      00000870
//                UNIT=&DSK,SPACE=(TRK,(1,10)),                                   00000880
//                DCB=(RECFM=VBS,LRECL=1452,BLKSIZE=1456,BUFNO=&B)                00000890
//FT42F001 DD &GRAPH,UNIT=&DSK,     OBSERVATION RESIDUALS FOR SCOPE               00000900
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),                  00000910
//                SPACE=(TRK,(1,10))                                              00000920
//FT43F001 DD &GRAPH,UNIT=&DSK,     SOLVE PARAMETERS FOR SCOPE                    00000930
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),                  00000940
//                SPACE=(TRK,(1,10))                                              00000950
//FT44F001 DD &GRAPH,UNIT=&DSK,     ELEMENTS FOR SCOPE                            00000960
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),                  00000970
//                SPACE=(TRK,(1,10))                                              00000980
//FT45F001 DD DSN=&F45,             SCRATCH ORBIT FILE                            00000990
//                UNIT=&DSK,                                                      00000991
//                DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,BUFNO=&B),                00001000
//                SPACE=(TRK,(200,20))                                            00001010
//FT46F001 DD DUMMY,                OBSERVATION SAVE                              00001020
//                DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=&B),         00001030
//                UNIT=&TAPE,LABEL=(,BLP),DISP=SHR                                00001040
//FT47F001 DD DUMMY                 URC PUNCH FILE                                00001050
//FT48F001 DD DUMMY,                EARTH/LUNAR POT FIELD WORKING FILE            00001060
//                UNIT=&DSK,SPACE=(4200,2),DCB=(DSORG=DA,BUFNO=&B)                00001070
//FT49F001 DD &GRAPH,UNIT=&DSK,     D. C. SUMMARY REPORT FOR SCOPE                00001080
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),                  00001090
//                SPACE=(TRK,(1,10))                                              00001100
//FT50F001 DD DDNAME=DODSUM         TRACKING DATA ACQUISITION SUMMARY             00001110
//FT51F001 DD DUMMY,                TELETYPE ELEMENTS REPORT                      00001120
//                DCB=(RECFM=FBA,LRECL=80,BLKSIZE=800,DEN=3,BUFNO=&B),            00001130
//                UNIT=&TAPE,LABEL=(,BLP),DISP=SHR                                00001140
//FT52F001 DD DUMMY,                DATA SIMULATION INPUT DODS TAPE               00001150
//                DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=&B),          00001160
//                UNIT=&TAPE,LABEL=(,BLP),DISP=SHR                                00001170
//FT53F001 DD DUMMY,                CAIRS REPORT FILE                             00001180
//                DCB=(RECFM=FB,LRECL=80,BLKSIZE=800),UNIT=&DSK,DISP=SHR          00001190
//FT54F001 DD DUMMY,                CHEBYSHEV EPHEMERIS FOR PDP-11                00001200
//                UNIT=TAPEDEN2,LABEL=(1,BLP),                                    00001210
//                DCB=(RECFM=FB,LRECL=316,BLKSIZE=316,DEN=2,BUFNO=&B)             00001220
//FT55F001 DD &GRAPH,UNIT=&UNIT     GRAPHICS DEVICE  (2250)                       00001230
//FT56F001 DD DUMMY,DISP=SHR        PARTIAL BATCH REQUEST FILE                    00001200
//FT57F001 DD DSN=&F57,             SCRATCH AREA FOR COMMON                       00001240
//                UNIT=&DSK,                                                      00001250
//                SPACE=(TRK,(5,2)),DCB=BUFNO=&B                                  00001260
//FT58F001 DD DSN=&F58,             IONOSPHERE WORKING FILE                       00001270
//                UNIT=&DSK,                                                      00001271
//                SPACE=(1332,20),DCB=(DSORG=DA,BUFNO=&B)                         00001280
```

Figure 5-2. Listing of the Procedure: UCLEG (3 of 5)

```
//FT59F001 DD DISP=SHR,DSN=&PRF..GTDS.SOLDAT.DATA,DCB=BUFNO=&B              00001290
//FT60F001 DD DISP=SHR,DSN=&PRF..GTDS.ACCOUNT.DATA,DCB=BUFNO=&B             00001300
//FT61F001 DD DSN=&F61,UNIT=&DSK,     RESIDUAL EDIT WORKING FILE            00001310
//             DCB=(RECFM=VBS,LRECL=564,BLKSIZE=6208,BUFNO=&B),             00001320
//             SPACE=(TRK,(200,10))                                         00001330
//FT62F001 DD DUMMY,UNIT=DISK,   RESIDUAL PLOT DATA FILE (DAIO)
//            DCB=(RECFM=FB,LRECL=160,BLKSIZE=3520,DSORG=DA),
//            DISP=(,PASS),SPACE=(TRK,(100,50),RLSE)
//FT63F001 DD DUMMY,                FLIGHT DIRECTOR'S REPORT                00001340
//            DCB=(DSORG=DA,BUFNO=&B)                                       00001340
//FT64F001 DD DUMMY,                SOR EXTRACT FILE                        00001350
//            DCB=(RECFM=VBS,LRECL=132,BLKSIZE=3304,DEN=3,BUFNO=&B),        00001360
//            UNIT=(TAPE,,DEFER),LABEL=(1,BLP),DISP=(,PASS),                00001370
//            VOL=SER=&SOREXT                                               00001380
//FT65F001 DD DSN=&F65,             IONOSPHERE WORKING FILE                 00001390
//            UNIT=&DSK,                                                    00001391
//            SPACE=(1176,62),DCB=(DSORG=DA,BUFNO=&B)                       00001400
//FT66F001 DD DUMMY,                IONSPHERIC SAVE FILE                    00001420
//            DCB=(RECFM=VBS,LRECL=1180,BLKSIZE=1184,BUFNO=&B),             00001430
//            SPACE=(TRK,(3,1),RLSE),UNIT=&DSK                              00001440
//FT67F001 DD DUMMY,                REAL TIME IONOSPHERE DATA               00001450
//            UNIT=&DSK,SPACE=(1432,151),DCB=(DSORG=DA,BUFNO=&B)            00001460
//FT68F001 DD DISP=SHR,DSN=&PRF..GTDS.TRODAT.DATA,DCB=BUFNO=&B              00001470
//FT69F001 DD &GRAPH.UNIT=&DSK,DISP=SHR,          PROMPTING                 00001480
//            DSN=&PRF..GTDS.PROMPT.DATA,DCB=(DSORG=DA,BUFNO=14)            00001490
//FT70F001 DD DUMMY                 GRAPHICS CARD INPUT FILE                00001500
//FT71F001 DD DUMMY               PRE-GENERATED INPUT ORBIT FILE RELAY 1    00001510
//FT72F001 DD DUMMY               PRE-GENERATED INPUT ORBIT FILE RELAY 2    00001520
//FT73F001 DD DUMMY               PRE-GENERATED INPUT ORBIT FILE RELAY 3    00001530
//FT74F001 DD &GRAPH.UNIT=&DSK,     GRAPHICS INTERRUPT FILE                 00001540
//            DCB=(RECFM=FB,LRECL=22,BLKSIZE=44),                           00001550
//            SPACE=(44,(2000,400)),DSN=&&GRNTR                             00001560
//FT75F001 DD DISP=SHR,DSN=&PRF..GTDS.JACCHIA.DATA,DCB=BUFNO=&B             00001570
//FT77F001 DD DSN=&F77,             EPHEM WORKING FILE                      00001580
//            UNIT=&DSK,                                                    00001590
//            SPACE=(TRK,(60,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)      00001600
//FT78F001 DD DISP=SHR,DSN=&PRF..GTDS.SLPTOD.DATA,DCB=BUFNO=&B              00001610
//FT79F001 DD DSN=ZBCOP.FSF.DATA, DISP=SHR FLIGHT SECTION FILE
//FT80F001 DD DUMMY,                TARGET SCRATCH ORBIT FILE               00001620
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),              00001630
//            SPACE=(TRK,(110,10)),UNIT=&DSK1                               00001640
//FT81F001 DD DSN=&F81,             2ND ORB1 OR EPHEM OUTPUT FILE           00001650
//            UNIT=&DSK,                                                    00001660
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)       00001670
//FT82F001 DD DUMMY,                COMPARE SEO ORBIT FILE 2, WITH PARTS    00001680
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),        00001690
//            UNIT=&TAPE,LABEL=(,BLP),DISP=SHR                              00001700
//FT83F001 DD DSN=&F83,             3RD ORB1 OR EPHEM OUTPUT FILE           00001710
//            UNIT=&DSK,                                                    00001720
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)       00001730
//FT84F001 DD DUMMY,                COMPARE SEO ORBIT FILE 2, W/O PARTS     00001740
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),        00001750
//            UNIT=&TAPE,LABEL=(,BLP),DISP=SHR                              00001760
//FT85F001 DD DSN=&F85,             4TH ORB1 OR EPHEM OUTPUT FILE           00001770
//            UNIT=&DSK,                                                    00001780
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)       00001790
//FT86F001 DD DUMMY,                COMPARE DA ORBIT FILE 2, WITH PARTS     00001800
//            UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),       00001810
//            SPACE=(1024,1500)                                             00001820
//FT87F001 DD DSN=&F87,             5TH ORB1 OR EPHEM OUTPUT FILE           00001830
//            UNIT=&DSK,                                                    00001840
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)       00001850
'/FT88F001 DD DUMMY,                COMPARE DA ORBIT FILE 2, W/O PARTIALS   00001860
//            UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),       00001870
//            SPACE=(1024,500)                                              00001880
//FT91F001 DD DUMMY,                USB OBSERVATIONS (60-BYTE)              00001890
```

Figure 5-2. Listing of the Procedure: UCLEG (4 of 5)

```
//            UNIT=&DSK,DCB=(RECFM=VBS,LRECL=64,BLKSIZE=6404,BUFNO=&B),
//            DISP=(OLD,DELETE)
//FT92F001 DD DSN=&F92,            ERROR ANALYSIS SUMMARY FILE
//            UNIT=&DSK,SPACE=(6220,(6,3)),
//            DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=&B)
//FT93F001 DD DSN=&F93,            ERROR ANALYSIS WORKING FILE
//            UNIT=&DSK,SPACE=(6220,(6,3)),
//            DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=&B)
//FT94F001 DD DUMMY,               OPTICAL ASPECT DATA
//            DCB=(RECFM=VBS,LRECL=28,BLKSIZE=564,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT95F001 DD DSN=&F95,            STATISTICAL OUTPUT REPORT FILE
//            UNIT=&DSK1,SPACE=(TRK,(100,20)),
//            DCB=(RECFM=FB,LRECL=160,BLKSIZE=9440,BUFNO=&B)
//FT96F001 DD DSN=&PRF..DBM60.DATA,             60-BYTE DATA BASE
//            DCB=BUFNO=&B,DISP=SHR
//FT97F001 DD DUMMY,               RELAY 1 SCRATCH ORBIT FILE
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//            SPACE=(TRK,(110,10)),UNIT=&DSK1
//FT98F001 DD DUMMY,               RELAY 2 SCRATCH ORBIT FILE
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//            SPACE=(TRK,(10,2)),UNIT=&DSK1
//FT99F001 DD DUMMY,               RELAY 3 SCRATCH ORBIT FILE
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//            SPACE=(TRK,(10,2)),UNIT=&DSK1
//INPUTPDS DD DUMMY,               CRT INPUT
//            UNIT=&DSK,DISP=SHR,
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=7200)
//NUCLEUS  DD DISP=SHR,VOL=REF=SYS1.SVCLIB,DCB=BUFNO=1
//SYSUDUMP DD SYSOUT=D
//ERRDUMP  DD &GRAPH.SYSOUT=&OUT,SPACE=(CYL,(0,4))
//*
```

Figure 5-2. Listing of the Procedure: UCLEG (5 of 5)

```
//     EXEC COM,PRGM=INDEX,BOX=FFF,COPY=02,SPON=GR211,STA=02,
//     REG=120K,
//     TITLE='  SFR 309 FINAL TEST RUN'
XXDEFAULT PROC REG=100K,BOX=,COPY=,PRGM=,TITLE=,              FGR/21AUG78  00000100
XX             SPON=,STA=                                                   00000200
XXCOM     EXEC PGM=COM,REGION=&REG,                                         00000300
IEF653I  SUBSTITUTION JCL - PGM=COM,REGION=120K,
XX             PARM=('BOX=&BOX,CORY=&CORY,PRGM=&PRGM,TITLE=&TITLE',        00000400
IEF653I  SUBSTITUTION JCL - PARM=('BOX=FFF,COPY=02,PRGM=INDEX,TITLE=   SFR 309 FINAL TEST RUN'
XX             'SPON=&SPON,STA=&STA')                                       00000500
IEF653I  SUBSTITUTION JCL - 'SPON=GR211,STA=02')
XXCOMPRINT DD  SYSOUT=A,DCB=(BLKSIZE=141,BUFNC=1)                           00000600
XXEZFEXTRN DD  DUMMY                                                        00000700
XXEZFOUTPT DD  DSN=&&COMOUT,UNIT=(2400-4,,DEFER),DISP=(NEW,KEEP),           00000800
XX             VOL=PRIVATE,                                                 00000900
XX             DCB=(RECFM=FB,LRECL=133,BLKSIZE=8512,DEN=3,BUFNO=1)          00001000
IEF648I  INVALID DISP FIELD- PASS SUBSTITUTED
XXEZFPAPER DD  DUMMY                                                        00001100
//EZFPARMS DD DSN=GRJJJ.COMPARM.DATA(DUMMY),DISP=SHR
X/EZFPARMS DD  DSN=SYS2.COMPARM(DUMMY),DISF=SHR,CCB=BUFNO=1                 00001200
XXEZFSTATS DD  SYSOUT=A,DCB=(BLKSIZE=1995,BUFNO=1)                          00001300
XXEZFXDISK DD  DUMMY                                                        00001400
XXSYSUDUMP DD  SYSOUT=A                                                     00001500
//SYSUT1 DD DSN=&&COM1,DISP=(OLD,DELETE)
//        DD DSN=&&COM2,DISP=(OLD,DELETE)
//        DD DSN=&&COM3,DISP=(OLD,DELETE)
//        DD DSN=&&COM4,DISP=(OLD,DELETE)
//
```

Figure 5-3. JCL for COM INDEXING

```
$REPORT-01 SETUP    INCC=MACH,CHANTBL=(CH1,3),                       GTDS COM INDEXING
                     INDXPG=((127,1,59),2,63,2,'.',0,0,0,NOEXTERN),  R.KUSESKI
                     INDXHDR=(('***INDEX RECORD***',X),(' ',1)),      CSC, X662
                     DEVICE=AUTOCOM,STARTADV=0
           MAJORBRK GRID=(1,4,'***      ***',1,61)
           INDEX     (LINE=(7,7),POSITION=(65,123),
                     MASK=(('AAAAABSB',57)))
           TITLE    SEGMENT=((3,1),3),
                    SEGMENT=((6,2),84,
                    '                                                ',
                    '          DATE=           TIME=           '),
                    SEGMENT=((12,3),36,
                    '                                      '),
                    DATA=((FSEQNO,3),1),DATA=(DATE,2,57),
                    DATA=(TIME,2,71)
$END
```

Figure 5-4. Example of EZFPARMS Specification

```
//**********************************************************
//VGTDSMOD PROC PRF=ORBIT,OUT='*',
//               MODULE='ZBCOP.GTDS30.LOAD1023',
//               GRAPH='DUMMY,',UNIT='2250-1',
//               DSK=SYSDA,DSK1=SYSDA,
//               TAPE=SYSDA,
//               B=2,G=2,
//               GTDPBF=NULLFILE,
//               GTPBRF=NULLFILE,
//               SOREXT=,
//*              OVRLY='TCSXX.GTDSREL3.OVERLAY.DATA',
//               OVRLY='TCSXX.ZB2CR.OVERLAY1.DATA',
//               DBM60='TCSXX.MAINT.G2DJC.DBM60'
//INMOD EXEC PGM=CHECK
//STEPLIB DD DSN=TCSXX.MAINT.CHECK.LOAD,DISP=SHR
//FT05F001 DD DDNAME=DATA5
//FT06F001 DD SYSOUT=*
//FT10F001 DD DSN=&&MODS,UNIT=&DSK,DISP=(,PASS),
// SPACE=(TRK,(30,30),RLSE),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//MODUPD   EXEC PGM=PAN#1,REGION=400K,COND=(4,LT)
//SYSPUNCH DD DUMMY
//SYSPRINT DD SYSOUT=*
//SYSIN    DD DSN=&&MODS,DISP=(OLD,DELETE)
//PANDD1   DD DSN=ZBCOP.GTDS30.PANSORCE,DISP=SHR
//PANDD2   DD DSN=&SCR,UNIT=&DSK,SPACE=(CYL,(20,5),RLSE),
//   DISP=(MOD,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//SOURCE  EXEC PGM=FORTVS,PARM='OPT(3),XREF,MAP,NOSDUMP,LC(78)',
//  REGION=2400K,COND=(4,LT)
//STEPLIB  DD  DISP=SHR,DSN=SYS2.FORTVS.R04M01
//SYSIN    DD  DSN=&SCR,DISP=(OLD,DELETE)
//SYSINDEX DD  SYSOUT=*
//SYSLIN   DD  DSN=&&OBJMOD,SPACE=(CYL,(20,5),RLSE),UNIT=&DSK,
//             DISP=(MOD,PASS),DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSPRINT DD  SYSOUT=*
//SYSPUNCH DD  SYSOUT=B,DCB=(BLKSIZE=2000,LRECL=80,RECFM=FB)
//SYSTERM  DD  SYSOUT=*
//SYSUT1   DD  UNIT=VIO,SPACE=(TRK,150),DCB=BLKSIZE=3465
//SYSUT2   DD  UNIT=VIO,SPACE=(TRK,150)
//SYSUDUMP DD  SYSOUT=D
//LINK EXEC PGM=IEWL,PARM='LET,OVLY,MAP,LIST,SIZE=(600K,100K)',
//   COND=(4,LT),REGION=2400K
//LOADLIB DD DUMMY
//NEWLIN  DD DUMMY
//SYSLIB  DD DSN=SYS0.LKEDLIB,DISP=SHR
//        DD DSN=SYS0.LKEDLIB,DISP=SHR
//        DD DSN=ZBCOP.COMREL3.NCAL4.LOAD,DISP=SHR
//        DD DSN=TCSXX.COMREL3.NCAL.LOAD,DISP=SHR
//        DD DSN=&MODULE,DISP=SHR
//        DD DSN=SYS2.VLNKMLIB.R04M01,DISP=SHR
//        DD DSN=SYS2.VFORTLIB.R04M01,DISP=SHR
//        DD DSN=SYS2.LKEDLIB,DISP=SHR
//        DD DSN=SYS3.LKEDLIB,DISP=SHR
//*
//*  THESE TWO DATASETS NEEDED FOR A SCRATCH BUILD
//*
//        DD DSN=ZBCOP.GTDSGSP.LOAD,DISP=SHR
//        DD DSN=SYS4.GSFCLIB,DISP=SHR
//SYSLMOD DD DSN=&&LOADMOD(GTDS),DISP=(,PASS),UNIT=&DSK,
//  SPACE=(TRK,(320,,1))
//SYSPRINT DD SYSOUT=*
//SYSUT1 DD UNIT=SYSDA,SPACE=(CYL,(8,4),RLSE)
//TAPELIB DD DUMMY,DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//SYSLIN DD DSN=&&OBJMOD,DISP=(OLD,DELETE),DCB=RECFM=FB
//       DD DSN=&OVRLY,DISP=SHR
//GO  EXEC PGM=*.LINK.SYSLMOD,COND=(4,LT),REGION=2000K
//FT00F001 DD DUMMY
```

Figure 5-5. JCL Procedure for Modifying VSFORTRAN Version of GTDS (1 of 5)

```
//FT01F001 DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=133)
//FT02F001 DD DISP=SHR,DSN=&PRF..GTDS.ATMOSDEN.DATA,DCB=BUFNO=&B
//FT03F001 DD DISP=SHR,DSN=&PRF..GTDS.MANEUVER.DATA,DCB=BUFNO=&B
//FT04F001 DD DISP=SHR,DSN=&PRF..GTDS.ASTROCON.DATA,DCB=BUFNO=&B
//FT05F001 DD DDNAME=DATA5
//*   FOR COM STEP CHOOSE BLKSIZE=6118
//FT06F001 DD SYSOUT=&OUT,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=133)
//FT07F001 DD SYSOUT=&OUT,DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160)
//FT08F001 DD DISP=SHR,DSN=&PRF..GTDS.EARTHFLD.DATA,DCB=BUFNO=&B
//FT09F001 DD DISP=SHR,DSN=&PRF..GTDS.LUNARFLD.DATA,DCB=BUFNO=&B
//FT10F001 DD DISP=SHR,DSN=&PRF..GTDS.INTCOEF.DATA,DCB=BUFNO=&B
//FT11F001 DD DISP=SHR,DSN=&PRF..GTDS.SECTIONS.DATA,DCB=BUFNO=&B
//FT12F001 DD &GRAPH.UNIT=&DSK,   TEMPORARY DATA FOR CRT INPUT MODE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             DISP=(NEW,DELETE),SPACE=(TRK,(1,1)),DSN=&&INPROMPT
//FT13F001 DD DISP=SHR,DSN=TCSXX.GTDS.ERRORMSG.DATA,DCB=BUFNO=1
//FT14F001 DD DISP=SHR,DSN=&PRF..GTDS.SLP1950.DATA,
//             LABEL=(,,,IN),DCB=BUFNO=&B
//FT15F001 DD DDNAME=OBSCARDS        OBSERVATION CARDS
//FT16F001 DD DSN=&F16,              DATA SIMULATION SUMMARY WORKING FILE
//             UNIT=&DSK,SPACE=(124,700),DCB=(DSORG=DA,BUFNO=&B)
//FT17F001 DD DSN=&F17,              OBSERVATIONS WORKING FILE
//             UNIT=&DSK1,
//             DCB=(RECFM=FB,LRECL=184,BLKSIZE=6072,BUFNO=&B),
//             SPACE=(6072,(100,40),,,ROUND)
//FT18F001 DD DSN=&F18,              SLP WORKING FILE
//             UNIT=&DSK,SPACE=(2264,48),DCB=(DSORG=DA,BUFNO=&B)
//FT19F001 DD DSN=&F19,              DISK ORBIT FILE WITH PARTIALS
//             DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//             UNIT=&DSK,SPACE=(1024,1500)
//FT20F001 DD DSN=&&F20,             DISK ORBIT FILE WITHOUT PARTIALS
//             UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//             SPACE=(1024,500)
//FT21F001 DD DSN=&&F21,             TAPE ORBIT FILE WITH PARTIALS
//             DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//             SPACE=(TRK,(1,10))
//FT22F001 DD DSN=&&F22,             TAPE ORBIT FILE WITHOUT PARTIALS
//             DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//             SPACE=(TRK,(1,10))
//FT23F001 DD &GRAPH.UNIT=&DSK,      ERROR MESSAGES FOR SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10)),DISP=(,PASS)
//FT24F001 DD DSN=&F24,              1ST ORB1 OR EPHEM OUTPUT FILE
//             UNIT=&DSK,DISP=(,PASS),
//             DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B),
//             SPACE=(TRK,(1,10))
//FT25F001 DD DISP=SHR,DSN=&PRF..GTDS.ELEMENTS.DATA,DCB=BUFNO=&B
//FT26F001 DD DSN=TCSXX.MAINT.TVHF.DATA,DISP=SHR  TCOPS VECTOR H. F.
//FT27F001 DD DISP=SHR,DSN=&PRF..GTDS.GEODTICS.DATA,DCB=BUFNO=&B
//FT28F001 DD &GRAPH.UNIT=&DSK,      SATELLITE EPHEMERIS TO SCOPE
//             DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//             SPACE=(TRK,(1,10))
//FT29F001 DD DSN=&&F29,             GTDS OBSERVATION TAPE FILE
//             DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),SPACE=(TRK,(1,10))
//FT30F001 DD DSN=&&F30,             DODS OBSERVATION TAPE
//             DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=&B),
//             UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),SPACE=(TRK,(1,10))
//FT31F001 DD DSN=&&F31,             GTDS OBSERVATION DISK FILE
//             UNIT=&DSK,DISP=(,PASS),
//             DCB=(RECFM=F,BLKSIZE=7200),
//             SPACE=(TRK,(2,10),RLSE)
//FT32F001 DD DSN=&GTDPBF,           60-BYTE PARTIAL BATCH FILE
//             DISP=SHR
```

Figure 5-5. JCL Procedure for Modifying VSFORTRAN Version of GTDS (2 of 5)

```
//FT33F001 DD DSN=&&F33,           SLP TAPE
//            DCB=(RECFM=VS,BLKSIZE=3460,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//            SPACE=(TRK,(1,10))
//FT34F001 DD DSN=&&F34,           JPL TAPE
//            DCB=(RECFM=VBS,LRECL=8304,BLKSIZE=8308,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP,,IN),DISP=(,PASS),
//            SPACE=(TRK,(1,10))
//FT35F001 DD &GRAPH.UNIT=&DSK,    INTEGRATION STATISTICS FOR SCOPE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//            SPACE=(TRK,(1,10))
//FT36F001 DD &GRAPH.UNIT=&DSK,    FINAL ORBIT GENERATOR DISPLAY FOR SCOP
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//            SPACE=(TRK,(1,10))
//FT37F001 DD DSN=&F37,            OBSERVATIONS SORT FILE
//            UNIT=&DSK,
//            DCB=(RECFM=VBS,LRECL=188,BLKSIZE=6208,BUFNO=&B),
//            SPACE=(TRK,(20,10))
//FT38F001 DD DISP=SHR,DSN=&PRF..GTDS.TIMCOF.DATA,DCB=BUFNO=&B
//FT39F001 DD DISP=SHR,DSN=&PRF..GTDS.GENCOF.DATA,DCB=BUFNO=&B
//FT40F001 DD DUMMY                PERMANENT FILES TO SCOPE
//FT41F001 DD DSN=&F41,            TEMPORARY STARTER ARRAYS
//            UNIT=&DSK,SPACE=(TRK,(1,10)),
//            DCB=(RECFM=VBS,LRECL=5796,BLKSIZE=5800,BUFNO=&B)
//FT42F001 DD &GRAPH.UNIT=&DSK,    OBSERVATION RESIDUALS FOR SCOPE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//            SPACE=(TRK,(1,10))
//FT43F0C1 DD &GRAPH.UNIT=&DSK,    SOLVE PARAMETERS FOR SCOPE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//            SPACE=(TRK,(1,10))
//FT44F001 DD &GRAPH.UNIT=&DSK,    ELEMENTS FOR SCOPE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//            SPACE=(TRK,(1,10))
//FT45F001 DD DSN=&F45,             SCRATCH ORBIT FILE
//            UNIT=&DSK,
//            DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=6172,BUFNO=&B),
//            SPACE=(CYL,(5,1))
//FT46F001 DD DSN=&&F46,           OBSERVATION SAVE
//            DCB=(RECFM=VBS,LRECL=7204,BLKSIZE=7208,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),SPACE=(TRK,(1,10))
//FT47F001 DD SYSOUT=*,            URC PUNCH FILE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=80)
//FT48F001 DD DSN=&&F48,           EARTH/LUNAR POT FIELD WORKING FILE
//            UNIT=&DSK,SPACE=(4200,2),DCB=(DSORG=DA,BUFNO=&B),
//            DISP=(,PASS)
//FT49F001 DD &GRAPH.UNIT=&DSK,    D. C. SUMMARY REPORT FOR SCOPE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200,BUFNO=&G),
//            SPACE=(TRK,(1,10))
//FT50F001 DD DDNAME=DODSUM        TRACKING DATA ACQUISITION SUMMARY
//FT51F001 DD DUMMY,               TELETYPE ELEMENTS REPORT
//            DCB=(RECFM=FBA,LRECL=80,BLKSIZE=800,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=SHR
//FT52F001 DD DSN=&&F52,           DATA SIMULATION INPUT DODS TAPE
//            DCB=(RECFM=VBS,LRECL=104,BLKSIZE=1044,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//            SPACE=(TRK,(1,10))
//FT53F001 DD DUMMY,               CAIRS REPORT FILE
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=800),UNIT=&DSK,DISP=SHR
//FT54F001 DD DSN=&&F54,           CHEBYSHEV EPHEMERIS FOR PDP-11
//            UNIT=&DSK,LABEL=(1,BLP),       UNIT=TAPEDEN2
//            DCB=(RECFM=FB,LRECL=316,BLKSIZE=316,DEN=2,BUFNO=&B),
//            SPACE=(TRK,(1,10))
//FT55F001 DD &GRAPH.UNIT=&UNIT    GRAPHICS DEVICE  (2250)
//*           DCB=GNCP=5
//FT56F001 DD DSN=&GTPBRF,         PARTIAL BATCH REQUEST FILE
//            DISP=SHR
```

Figure 5-5. JCL Procedure for Modifying VSFORTRAN Version of GTDS (3 of 5)

```
//FT57F001 DD DSN=&F57,          SCRATCH AREA FOR COMMON
//            UNIT=&DSK,
//            SPACE=(TRK,(10,5)),DCB=BUFNO=&B
//FT58F001 DD DSN=&F58,          IONOSPHERE WORKING FILE
//            UNIT=&DSK,
//            SPACE=(1332,20),DCB=(DSORG=DA,BUFNO=&B)
//FT59F001 DD DISP=SHR,DSN=&PRF..GTDS.SOLDAT.DATA,DCB=BUFNO=&B
//FT60F001 DD DISP=SHR,DSN=&PRF..GTDS.ACCOUNT.DATA,DCB=BUFNO=&B
//FT61F001 DD DSN=&F61,UNIT=&DSK,     RESIDUAL EDIT WORKING FILE
//            DCB=(RECFM=VBS,LRECL=564,BLKSIZE=6208,BUFNO=&B),
//            SPACE=(CYL,(6,1))
//FT62F001 DD DUMMY,UNIT=&DSK,     RESIDUAL PLOT DATA FILE (DAIO)
//         DCB=(RECFM=FB,LRECL=160,BLKSIZE=3520,DSORG=DA),
//         DISP=(,PASS),SPACE=(TRK,(100,50),RLSE)
//FT63F001 DD DUMMY,             FLIGHT DIRECTOR'S REPORT
//            DCB=(DSORG=DA,BUFNO=&B)
//FT64F001 DD DSN=&&F64,         SOR EXTRACT FILE
//            DCB=(RECFM=VBS,LRECL=132,BLKSIZE=3304,DEN=3,BUFNO=&B),
//*           UNIT=(&TAPE,,DEFER),LABEL=(1,BLP),DISP=(,PASS),
//            UNIT=&DSK,DISP=(,PASS),SPACE=(TRK,(1,10)),
//            VOL=SER=&SOREXT
//FT65F001 DD DSN=&&F65,         IONOSPHERE WORKING FILE
//            UNIT=&DSK,DISP=(,PASS),
//            SPACE=(1176,62),DCB=(DSORG=DA,BUFNO=&B)
//FT66F001 DD DSN=&&F66,         IONSPHERIC SAVE FILE
//            DCB=(RECFM=VBS,LRECL=1180,BLKSIZE=1184,BUFNO=&B),
//            SPACE=(TRK,(3,1),RLSE),UNIT=&DSK
//FT67F001 DD DSN=&&F67,         REAL TIME IONOSPHERE DATA
//            UNIT=&DSK,SPACE=(1432,151),DCB=(DSORG=DA,BUFNO=&B),
//            DISP=(,PASS)
//FT68F001 DD DISP=SHR,DSN=&PRF..GTDS.TRODAT.DATA,DCB=BUFNO=&B
//FT69F001 DD &GRAPH,UNIT=&DSK,DISP=SHR,          PROMPTING
//            DSN=ORBIT.GTDS.PROMPT.DATA,DCB=(DSORG=DA,BUFNO=14)
//FT70F001 DD DUMMY              GRAPHICS CARD INPUT FILE
//FT71F001 DD DUMMY            PRE-GENERATED INPUT ORBIT FILE RELAY 1
//FT72F001 DD DUMMY            PRE-GENERATED INPUT ORBIT FILE RELAY 2
//FT73F001 DD DUMMY            PRE-GENERATED INPUT ORBIT FILE RELAY 3
//FT74F001 DD &GRAPH,UNIT=&DSK,  GRAPHICS INTERRUPT FILE
//            DCB=(RECFM=FB,LRECL=22,BLKSIZE=2200,BUFNO=&G),
//            SPACE=(TRK,(1,1)),DSN=&GRNTR
//FT75F001 DD DISP=SHR,DSN=&PRF..GTDS.JACCHIA.DATA,DCB=BUFNO=&B
//FT76F001 DD DSN=&F76,          GMAN OUTPUT FILE
//            UNIT=&DSK,
//            SPACE=(TRK,(1,10)),DISP=(,PASS),
//            DCB=(RECFM=VBS,BLKSIZE=6764,LRECL=1940)
//FT77F001 DD DSN=&F77,          EPHEM WORKING FILE
//            UNIT=&DSK,
//            SPACE=(2800,350),DCB=(RECFM=F,BLKSIZE=2800,BUFNO=&B)
//FT78F001 DD DISP=SHR,DSN=&PRF..GTDS.SLPTOD.DATA,DCB=BUFNO=&B
//FT79F001 DD DSN=TCSXX.FSF.DATA,DISP=SHR  FLIGHT SECTIONING FILE
//FT80F001 DD DUMMY,             TARGET SCRATCH ORBIT FILE
//            DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//            SPACE=(CYL,(4,1)),UNIT=&DSK1
//FT81F001 DD DSN=&F81,          2ND ORB1 OR EPHEM OUTPUT FILE
//            UNIT=&DSK,
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT82F001 DD DSN=&&F82,         COMPARE SEQ ORBIT FILE 2, WITH PARTS
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//            SPACE=(TRK,(1,10))
//FT83F001 DD DSN=&&F83,         3RD ORB1 OR EPHEM OUTPUT FILE
//            UNIT=&DSK,DISP=(,PASS),
//            SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT84F001 DD DSN=&&F84,         COMPARE SEQ ORBIT FILE 2, W/O PARTS
//            DCB=(RECFM=VS,LRECL=1028,BLKSIZE=6172,DEN=3,BUFNO=&B),
//            UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
```

Figure 5-5. JCL Procedure for Modifying VSFORTRAN Version of GTDS (4 of 5)

```
//              SPACE=(TRK,(1,10))
//FT85F001 DD DSN=&&F85,              4TH ORB1 OR EPHEM OUTPUT FILE
//              UNIT=&DSK,DISP=(,PASS),
//              SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT86F001 DD DSN=&&F86,              COMPARE DA ORBIT FILE 2, WITH PARTS
//              UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//              SPACE=(1024,1500),DISP=(,PASS)
//FT87F001 DD DSN=&&F87,              5TH ORB1 OR EPHEM OUTPUT FILE
//              UNIT=&DSK,DISP=(,PASS),
//              SPACE=(TRK,(1,10)),DCB=(RECFM=VS,BLKSIZE=2808,BUFNO=&B)
//FT88F001 DD DSN=&&F88,              COMPARE DA ORBIT FILE 2, W/O PARTIALS
//              UNIT=&DSK,DCB=(RECFM=F,BLKSIZE=1024,DSORG=DA,BUFNO=&B),
//              SPACE=(1024,500)
//FT91F001 DD DSN=&&F91,              USB OBSERVATIONS (60-BYTE)
//              UNIT=&DSK,DCB=(RECFM=VBS,LRECL=64,BLKSIZE=6404,BUFNO=&B),
//              DISP=(,PASS),SPACE=(TRK,(1,10))
//FT92F001 DD DSN=&F92,               ERROR ANALYSIS SUMMARY FILE
//              UNIT=&DSK,SPACE=(6220,(6,3)),
//              DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=&B)
//FT93F001 DD DSN=&F93,               ERROR ANALYSIS WORKING FILE
//              UNIT=&DSK,SPACE=(6220,(6,3)),
//              DCB=(RECFM=VBS,LRECL=148,BLKSIZE=6220,BUFNO=&B)
//FT94F001 DD DSN=&&F94,              OPTICAL ASPECT DATA
//              DCB=(RECFM=VBS,LRECL=28,BLKSIZE=564,DEN=3,BUFNO=&B),
//              UNIT=&TAPE,LABEL=(,BLP),DISP=(,PASS),
//              SPACE=(TRK,(1,10))
//FT95F001 DD DSN=&F95,               STATISTICAL OUTPUT REPORT FILE
//              UNIT=&DSK1,SPACE=(CYL,(4,1)),
//              DCB=(RECFM=FB,LRECL=160,BLKSIZE=9440,BUFNO=&B)
//FT96F001 DD DSN=&DBM60,             60-BYTE DATA BASE
//              DCB=BUFNO=&B,DISP=SHR
//FT97F001 DD DUMMY,                  RELAY 1 SCRATCH ORBIT FILE
//              DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//              SPACE=(CYL,(4,1)),UNIT=&DSK1
//FT98F001 DD DUMMY,                  RELAY 2 SCRATCH ORBIT FILE
//              DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//              SPACE=(TRK,(10,2)),UNIT=&DSK1
//FT99F001 DD DUMMY,                  RELAY 3 SCRATCH ORBIT FILE
//              DCB=(RECFM=FB,LRECL=1024,BLKSIZE=6144,BUFNO=&B),
//              SPACE=(TRK,(10,2)),UNIT=&DSK1
//INPUTPDS DD DUMMY,                  CRT INPUT
//              UNIT=&DSK,DISP=SHR,
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=7200)
//NUCLEUS  DD DISP=SHR,VOL=REF=SYS1.SVCLIB,DCB=BUFNO=1
//SYSUDUMP DD SYSOUT=&OUT,OUTLIM=2000
//ERRDUMP  DD &GRAPH.SYSOUT=&OUT
//*
//*
```

Figure 5-5. JCL Procedure for Modifying VSFORTRAN Version of GTDS (5 of 5)

APPENDIX A - STATE SOLVE-FOR PARAMETER TYPE INDICATORS AND OBSERVATION AND STATION-RELATED INDEXES AND VALUES

The following tables provide the state solve-for parameter type indicators and observation and station-related indexes and values.

Table A-1. State Solve-For Parameter Type Indicators

PARAMETER TYPE CODE	CARTESIAN	KEPLERIAN	SPHERICAL	DODS UNKNOWNS
1	X COMPONENT OF POSITION, X	SEMIMAJOR AXIS, a	RIGHT ASCENSION, α	f (SEMIMAJOR AXIS)[1], X_1
2	Y COMPONENT OF POSITION, Y	ECCENTRICITY, e	DECLINATION, δ	f (ECCENTRICITY), X_2
3	Z COMPONENT OF POSITION, Z	INCLINATION, i	VEHICLE FLIGHT PATH ANGLE, γ	f (TRUE ANOMALY), X_3
4	X COMPONENT OF VELOCITY, X	LONGITUDE OF ASCENDING NODE, Ω	AZIMUTH, β	f (ROTATION ABOUT α), X_4
5	Y COMPONENT OF VELOCITY, Y	ARGUMENT OF PERIGEE, ω	RADIUS, r	f (ROTATION ABOUT β), X_5
6	Z COMPONENT OF VELOCITY, Z	MEAN ANOMALY, M	VELOCITY, V	f (ROTATION ABOUT γ), X_6
7				f (RADIAL DISTANCE), X_7
8				f (VELOCITY), X_8
9				f (FLIGHT PATH ANGLE), X_9
19				f (LONGITUDE OF PERIHELION), X_{19}

[1] f REFERS TO "FUNCTION OF" (i.e., X_1 IS A FUNCTION OF SEMIMAJOR AXIS).

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Table A-2. Observation Type Indicators (1 of 4)

OBSERVATION TYPE	GTDS TYPE NUMBER	TRACKING SYSTEM	WEIGHT INDEX	UNITS	DEFAULT[1] STANDARD DEVIATION	DATA ACRONYM
RANGE	1	GRARR-VHF	1	KM	500 M	RANG
L	2	MINITRACK	2		.3 MILS	L
M	3	MINITRACK	3		.3 MILS	M
AZIMUTH	4	C-BAND	4	RAD	618" ARC	AZ
ELEVATION	5	C-BAND	5	RAD	618" ARC	EL
RIGHT ASCENSION	6	OPTICAL	6	RAD	180" ARC	RA
DECLINATION	7	OPTICAL	7	RAD	180" ARC	DEC
HOUR ANGLE	8	OPTICAL	8	RAD	180" ARC	HA
RANGE-RATE	9	GRARR-VHF	9	KM/SEC	30 CM/SEC	RRAT
RANGE-RATE	10	USB	10	KM/SEC	2 CM/SEC	URDF
X85	11	USB/SRE	11	RAD	3506" ARC	UX85
Y85	12	USB/SRE	12	RAD	3506" ARC	UY85
RANGE	13	USB	13	KM	15 M	URAN
X30	14	USB/SRE[2]	14	RAD	3506" ARC	UX30
Y30	15	USB/SRE[2]	15	RAD	3506" ARC	UY30
X30	17	GRARR-VHF	17	RAD	3506" ARC	X30
Y30	18	GRARR-VHF	18	RAD	3506" ARC	Y30
RANGE DIFFERENCE	19	GRARR-VHF	19	KM/SEC	30 CM/SEC	RDIF
X-POSITION	21	PCE	21	KM	100 M	X
Y-POSITION	22	PCE	22	KM	100 M	Y
Z-POSITION	23	PCE	23	KM	100 M	Z
X-VELOCITY	24	PCE	24	KM	10 CM/SEC	XDOT
Y-VELOCITY	25	PCE	25	KM	10 CM/SEC	YDOT
Z-VELOCITY	26	PCE	26	KM	10 CM/SEC	ZDOT
RANGE	1	C-BAND	27	KM	37.57 M	CRAN
RANGE-RATE	9	GRARR S-BAND	28	KM/SEC	10.64 CM/SEC	SRRT
RANGE	1	GRARR S-BAND	29	KM	37.57 M	SRAN
X14	17	GRARR S-BAND	31	RAD	3506" ARC	X14
Y14	18	GRARR S-BAND	32	RAD	3506" ARC	Y14
X14	11, 14	SRE	31	RAD	3506" ARC	X14
Y14	12, 15	SRE	32	RAD	3506" ARC	Y14
RANGE	1	LASER	33	KM	10 M	LRAN

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Table A-2. Observation Type Indicators (2 of 4)

OBSERVATION TYPE	GTDS TYPE NUMBER	TRACKING SYSTEM	WEIGHT INDEX	UNITS	DEFAULT[1] STANDARD DEVIATION	DATA ACRONYM
X30	17	LASER	34	RAD	3600° ARC	LX30
Y30	18	LASER	35	RAD	3600° ARC	LY30
AZIMUTH	4	LASER	36	RAD	3600° ARC	LAZ
ELEVATION	5	LASER	37	RAD	3600° ARC	LEL
X40	17	X-Y PARABOLIC	38	RAD	3600° ARC	X40
Y40	18	X-Y PARABOLIC	39	RAD	3600° ARC	Y40
X85	17	X-Y PARABOLIC	40	RAD	3600° ARC	X85
Y85	18	X-Y PARABOLIC	41	RAD	3600° ARC	Y85
RANGE (SIDETONE)	1	ATSR	42	KM	10 M	RNGA
RANGE (COHERENT)	42	ATSR	42	KM	10 M	RNGS
RANGE SUM (RELAY)	43	ATSR	43	KM	20 M	RNGS
DESTRUCT DOPPLER (COHERENT)	44	ATSR	44	HZ	.040 HZ	DPLA
DESTRUCT DOPPLER (TRANSPONDER)	45	ATSR	45	HZ	.012 HZ	DPLT
DESTRUCT DOPPLER (SST)	46	ATSR	46	HZ	.300 HZ	DPLS
NON-DESTRUCT DOPPLER (COHERENT)	47	ATSR	47	HZ	.040 HZ	DPLA
NON-DESTRUCT DOPPLER (TRANSPONDER)	48	ATSR	48	HZ	.012 HZ	DPLT
NON-DESTRUCT DOPPLER (SST)	49	ATSR	49	HZ	.300 HZ	DPLS
RANGE-RATE (SIDETONE)	9	ATSR	50	KM/SEC	5 CM/SEC	ARRT
SUN ANGLE	52	ATTITUDE	52	RAD	1800° ARC	SUN
EARTH IN TIME	53	ATTITUDE	53	SECOND	.0025 SEC	TIN
EARTH OUT TIME	54	ATTITUDE	54	SECOND	.0025 SEC	TOUT
SOLAR OCCULTATION TIME	55	ATTITUDE	55	SECOND	1 SEC	SOCT
RANGE	13	SRE	56	KM	15 M	URAN
RANGE RATE	10	SRE	57	KM/SEC	2 CM/SEC	URDF
AZIMUTH	4	SRE	58	RAD	3600° ARC	SAZ
ELEVATION	5	SRE	59	RAD	3600° ARC	SEL
AZIMUTH	4	DSN	60	RAD	3600° ARC	DAZ
ELEMENT NUMBER	61	LANDMARK	61	ELEMENT	2 ELEMENTS	ELEM
LINE NUMBER	62	LANDMARK	62	LINE	2 LINES	LINE
PEE ELEMENT NUMBER	63	LANDMARK	63	ELEMENT	2 ELEMENTS	ELEC
PEE LINE NUMBER	64	LANDMARK	64	LINE	2 LINES	LINC
SUN ANGLE	65	LANDMARK	65	RAD	17.7388° ARC	SCAN

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Table A-2. Observation Type Indicators (3 of 4)

OBSERVATION TYPE	GTDS TYPE NUMBER	TRACKING SYSTEM	WEIGHT INDEX	UNITS	DEFAULT[1] STANDARD DEVIATION	DATA ACRONYM
ELEVATION ANGLE	66	LANDMARK	66	RAD	17.7388° ARC	ELEV
EARTH IN TIME	67	LANDMARK	67	SECOND	16 μs	TIN
EARTH OUT TIME	68	LANDMARK	68	SECOND	16 μs	TOUT
RANGE	13	DSN	69	KM	15 M	DRAN
RANGE-RATE	10	DSN	70	KM/SEC	2 CM/SEC	DRAT
RANGE	1	SGLS	71	KM	6.096 M	COR
RANGE DIFFERENCE	19	SGLS	72	KM/SEC	8.5344 CM/SEC	CORR
AZIMUTH	4	SGLS	73	RAD	72° ARC	COAZ
ELEVATION	5	SGLS	74	RAD	72° ARC	COEL
ELEVATION	5	DSN	75	RAD	3800° ARC	DEL
RANGE-RATE	10	SRE-VHF	76	KM/SEC	20 CM/SEC	SVRR
RANGE	13	SRE-VHF	77	KM	100 M	SVR
X-ANGLE	11, 14	SRE-VHF	78	RAD	3600° ARC	SVX
Y-ANGLE	12, 15	SRE-VHF	79	RAD	3600° ARC	SVY
X30 ATSR	17	ATSR	17	RAD	3506° ARC	X30
Y30 ATSR	18	ATSR	18	RAD	3506° ARC	Y30
RANGE 2-WAY RELAY	80	TDRS	80	KM	30 M	TR2S
RANGE HYBRID RELAY	81	TDRS	81	KM	30 M	TRHS
RANGE 2-WAY GROUND TRANSPONDER	82	TDRS	82	KM	10 M	TR2G
RANGE HYBRID GROUND TRANSPONDER	83	TDRS	83	KM	10 M	TRHG
DOPPLER 1-WAY S-BAND RELAY	84	TDRS	84	HZ	200 HZ	TD1S
DOPPLER 1-WAY K-BAND RELAY	84	TDRS	84	HZ	1000 HZ	TD1S
DOPPLER 2-WAY S-BAND RELAY	85	TDRS	85	HZ	.25 HZ	TD2S
DOPPLER 2-WAY K-BAND RELAY	85	TDRS	85	HZ	1.50 HZ	TD2S
DOPPLER HYBRID RELAY	86	TDRS	86	HZ	.25 HZ	TDHS
DOPPLER Δ1-WAY DIFFERENCED RELAY	87	TDRS	87	HZ	.25 HZ	TDDS
DOPPLER 1-WAY GROUND TRANSPONDER	88	TDRS	88	HZ	200 HZ	TD1G
DOPPLER 2-WAY HIGH-RATE GROUND XPNDR	89	TDRS	89	HZ	.020 HZ	TD2G
DOPPLER 2-WAY MED-RATE GROUND XPNDR	89	TDRS	89	HZ	.005 HZ	TD2G
DOPPLER 2-WAY LOW-RATE GROUND XPNDR	89	TDRS	89	HZ	.003 HZ	TD2G
DOPPLER 2-WAY HIGH-RATE GROUND XPNDR	90	TDRS	90	HZ	.020 HZ	TDHG

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Table A-2. Observation Type Indicators (4 of 4)

OBSERVATION TYPE	GTDS TYPE NUMBER	TRACKING SYSTEM	WEIGHT INDEX	UNITS	DEFAULT[1] STANDARD DEVIATION	DATA ACRONYM
DOPPLER HYBRID MED-RATE GROUND XPNDR	90	TDRS	90	HZ	.005 HZ	TDHG
DOPPLER HYBRID LOW-RATE GROUND XPNDR	90	TDRS	90	HZ	.003 HZ	TDHG
DOPPLER Δ1-WAY HIGH-RATE GROUND XPNDR	91	TDRS	91	HZ	.25 HZ	TDDG
DOPPLER Δ1-WAY MED-RATE GROUND XPNDR	91	TDRS	91	HZ	.10 HZ	TDDG
DOPPLER Δ1-WAY LOW-RATE GROUND XPNDR	91	TDRS	91	HZ	.05 HZ	TDDG
AZIMUTH	92	TDRS	92	RAD	36" ARC	TDAZ
ELEVATION	93	TDRS	93	RAD	36" ARC	TDEL
R.F. BEAM ANG #1	95	TDRS	95	RAD	360" ARC	TRF1
R.F. BEAM ANG #1 MULTIPLE ACCESS	95	TDRS	95	RAD	720" ARC	TRF1
R.F. BEAM ANG #2	96	TDRS	96	RAD	360" ARC	TRF2
R.F. BEAM ANG #2 MULTIPLE ACCESS	96	TDRS	96	RAD	720" ARC	TRF2

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[1] APPLIES TO OBSERVATIONS IN 60-BYTE FORMAT WHEN STATISTICAL OUTPUT REPORT (SOR) IS NOT REQUESTED AND OBSERVATIONS IN 100-BYTE FORMAT.

[2] THE ORIENTATIONS OF ANGLES FOR USB30 TRACKERS WITH ACRONYMS ENDING IN A ARE IDENTICAL TO THOSE OF USB85 ANGLES. THEREFORE, THOSE USB30 ANGLES HAVE THE SAME GTDS OBSERVATION TYPE NUMBERS AS USB85 ANGLES. WHEN INPUTTING OBSERVATION TYPE NUMBERS ON KEYWORD CARDS A*******, D*******, AND /*******5 (STATION CARD 5), THE GTDS OBSERVATION TYPE NUMBERS FOR USB85 ANGLES, 11 AND 12, MUST BE USED FOR THOSE USB30 ANGLES. HOWEVER, WHEN INPUTTING OBSERVATION TYPE NUMBERS ON KEYWORD CARDS CHWT****, MIXPAIR, SORINPUT, AND OBSDEV, THE GTDS OBSERVATION TYPE NUMBERS FOR REGULAR USB30 ANGLES, 14 AND 15, SHOULD BE USED FOR THOSE USB30 ANGLES BECAUSE THEY STILL BELONG TO THE SAME SOR CATEGORIES OF THE REGULAR USB30 ANGLES.

Table A-3. Observation Corrections

CORRECTION	APPLICABLE GTDS TYPE
LIGHT TIME	1, 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19
REFRACTION	1, 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19
	80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93
TRANSPONDER DELAY	1, 13
GROUND ANTENNA MOUNT	1, 9, 10, 13, 19
SPACECRAFT ANTENNA OFFSET	15, 17

149-2/11-87/[1]

Table A-4. SOR Categories With Maximum O-C Values and Noise Standard Deviations (1 of 4)

Tracking System and SOR Category	Maximum O-C	Noise Standard Deviation[1]	Units
C-Band			
Range	150	20	m
Azimuth	0.150	0.020	deg
Elevation	0.150	0.015	deg
USB			
Range	150	20	m
Range Rate	2	0.1	m/sec
SRE			
Range	150	20	m
Range Rate	2	0.1	deg
SRE/USB			
X30	0.2	0.025	deg
Y30	0.2	0.020	deg
X85	0.150	0.025	deg
Y85	0.150	0.020	deg
SRE/GRARR S-Band			
X14	1.0	0.2	deg
Y14	1.0	0.2	deg
GRARR S-Band			
Range	150	20	m
Range Rate	2	0.1	m/sec
GRARR VHF			
X30	2.5	0.5	deg
Y30	2.5	0.5	deg
Range	1000	200	m
Range Rate	5	1	m/sec
MINITRACK			
L Equatorial	500 counts	0.26	mils
M Equatorial	500 counts	0.26	mils
L Polar	500 counts	0.18	mils
M Polar	500 counts	0.18	mils

[1] Apply to observations input in 60-byte format when SOR is requested.

Table A-4. SOR Categories With Maximum O-C Values and Noise Standard Deviations (2 of 4)

Tracking System and SOR Category	Maximum O-C	Noise Standard Deviation[1]	Units
DSN			
Range	150	20	m
Range Rate	2	0.1	m/sec
Azimuth	0.15	0.02	deg
Elevation	0.15	0.02	deg
LASER			
X30	0.2	0.1	deg
Y30	0.1	0.1	deg
Azimuth	0.2	0.1	deg
Elevation	0.1	0.1	deg
Range	150	0.015	m
XY			
X40	2	0.3	deg
Y40	2	0.3	deg
X85	1	0.1	deg
Y85	1	0.1	deg
ATSR			
Angle			
X30	0.5	0.18	deg
Y30	0.5	0.18	deg
Azimuth	0.5	0.03	deg
Elevation	0.5	0.03	deg
Range			
Direct	100	10	m
Ground Relay	100	20	m
Satellite-to-Satellite	750	30	m
Range Rate			
Sidetone Destruct, 1 sec rate[2]	2	0.080	m/sec
Sidetone Destruct, 1 sec rate	0.5	0.020	m/sec
Coherent Destruct, 1 sec rate	0.004 m/sec	0.0003	m/sec
Coherent Destruct, 1 sec rate	0.02 m/sec	0.0015	m/sec

[1] Apply to observations input in 60-byte format when SOR is requested.

[2] 1 sec rate = one or more observations in 1 second.

Table A-4. SOR Categories With Maximum O-C Values and Noise Standard Deviations (3 of 4)

Tracking System and SOR Category	Maximum O-C	Noise Standard Deviation[1]	Units
Coherent Nondestruct, 1 sec rate	0.008 m/sec	0.0003	m/sec
Coherent Nondestruct, 1 sec rate	0.02 m/sec	0.0015	m/sec
PLL Destruct, Ground Relay, 1 sec rate	0.2	0.012	Hz
PLL Destruct, Ground Relay, 1 sec rate	0.4	0.060	Hz
PLL Nondestruct, Ground Relay, 1 sec rate	0.2	0.012	Hz
PLL Nondestruct, Ground Relay, 1 sec rate	0.4	0.060	Hz
PLL Destruct, Satellite-to-Satellite	20	0.300	Hz
PLL Nondestruct, Satellite-to-Satellite	20	0.300	Hz
Crystal Destruct, Ground Relay, < 1 sec rate	0.2	0.012	Hz
Crystal Destruct, Ground Relay 1 sec rate[2]	0.4	0.060	Hz
Crystal Destruct, Satellite-to-Satellite	20	0.300	Hz
OPTICAL			
Right Ascension	0.25	0.05	deg
Declination	0.25	0.05	deg
Hour Angle	0.25	0.05	deg
SRE VHF			
X-Angle	5	1	deg
Y-Angle	5	1	deg
Range	750	100	m
Range Rate	3	0.2	m/sec

[1] Apply to observations input in 60-byte format when SOR is requested.

[2] 1 sec rate = one or more observations in 1 second.

Table A-4. SOR Categories With Maximum O-C Values and Noise Standard Deviations (4 of 4)

Tracking System and SOR Category	Maximum O-C	Noise Standard Deviation[1]	Units
SGLS			
Range	1000	6.096	m
Range Difference	90	0.085344	m/sec
Azimuth	0.15	0.02	deg
Elevation	0.15	0.02	deg
TDRSS			
Two-Way Range	750	30	m
Hybrid Range	750	30	m
Two-Way Range-Ground Relay	100	10	m
Hybrid Range-Ground Relay	100	10	m
One-Way Doppler (S-Band)	1000	200	Hz
One-Way Doppler (K-Band)	5000	1000	Hz
Two-Way Doppler (S-Band)	20	0.25	Hz
Two-Way Doppler (K-Band)	100	1.50	Hz
Hybrid Doppler	20	0.25	Hz
Differenced One-Way Doppler	20	0.25	Hz
One-Way Doppler Ground Relay	1000	200	Hz
Two-Way Doppler Ground Relay			
Low Data Rate	0.05	0.003	Hz
Medium Data Rate	0.05	0.005	Hz
High Data Rate	0.10	0.020	Hz
Differenced One-Way Doppler Ground Relay			
Low Data Rate	0.5	0.05	Hz
Medium Data Rate	1	0.10	Hz
High Data Rate	2	0.25	Hz

[1] Apply to observations input in 60-byte format when SOR is requested.

Table A-4a. SOR Categories With Maximum O-C Values and Noise Standard Deviations (4 of 4)

Tracking System and SOR Category	Maximum O-C	Noise Standard Deviation[1]	Units
Azimuth	0.15	0.01	deg
Elevation	0.15	0.01	deg
RF Beam Azimuth			
S.A. Antenna 1	0.3	0.1	deg
S.A. Antenna 2	0.6	0.2	deg
RF Beam Elevation			
S.A. Antenna 1	0.3	0.1	deg
S.A. Antenna 2	0.6	0.2	deg

Table A-5. Station Indexes and Acronyms for 60-Byte Data (1 of 8)

Index Number	Station Acronym	External Station ID	Description
A. USB/SRE Tracking System			
42	ACNY	93	Ascension Island (SRE-VHF)
21	ACNZ	72	Ascension Island (SRE-VHF)
9	ACN3	75	Ascension Island (USB, 9 meters)
10	AGO3	54	Santiago, Chile (USB, 9 meters)
11	BDA3	02	Bermuda (USB, 9 meters)
1	BLTA	91	Greenbelt, Maryland (USB, 26 meters, ERTS, E-W keyhole)
27	BLTX	45	Greenbelt, Maryland (SRE-VHF)
43	BLTY	94	Greenbelt, Maryland (SRE-VHF)
22	BLTZ	73	Greenbelt, Maryland (SRE-VHF)
13	BLT3	77	Greenbelt, Maryland (USB, 9 meters)
41	BL2Y	78	Greenbelt, Maryland (SRE-VHF)
24	BL2Z	None	Greenbelt, Maryland (SRE-VHF)
17	DS46	46	Canberra, Australia (USB, 26 meters)
2	GDSA	14	Goldstone, California (USB, 9 meters, ERTS, E-W keyhole)
18	DS17	16	Goldstone, California (USB, 9 meters)
3	DS16	28	Goldstone, California (USB, 26 meters E-W keyhole)
20	GT28	17	Goldstone, California (USB, 26 meters)
44	GWMY	95	Guam Island (SRE-VHF)
14	GWM3	24	Guam Island (USB, 9 meters)
23	GW3Z	74	Guam Island (SRE-VHF)
15	HAW3	12	Kauai, Hawaii (USB, 9 meters)
38	HA2Y	34	Kauai, Hawaii (SRE-VHF)
19	MAD3	22	Madrid, Spain (USB, 9 meters)

Table A-5. Station Indexes and Acronyms for 60-Byte Data (2 of 8)

Index Number	Station Acronym	External Station ID	Description
4	MAD8	23	Madrid, Spain (USB, 26 meters, E-W keyhole)
5	MILA	40	Merritt Island, Florida (USB, 9 meters)
16	MIL3	71	Merritt Island, Florida (USB 1, 9 meters)
39	OR3Y	36	Orroral, Australia (SRE-VHF)
32	OUIS	06	Quito, Ecuador (SRE, 4.3 meters)
37	QU3Y	66	Quito, Ecuador (SRE-VHF)
6	DS66	66	Madrid, Spain (USB,26 meters)
33	ROSS	31	Rosman, North Carolina (SRE 4.3 meters)
12	UL23	79	Fairbanks, Alaska (USB, 26 meters)
29	UL33	90	Fairbanks, alaska (USB, 26 meters)
28	VDB3	03	Vandenberg AFB, California (USB, 9 meters)
25	WPSA	04	Wallops Island, Virginia
24	WPSS	05	Wallops Island, Virginia
26	WPS8	07	Wallops Island, Virginia
32	WP2S	08	Wallops Island, Virginia
33	WPSX	18	Wallops Island, Virginia (SRE-VHF)
34	WPSY	20	Wallops Island, Virginia (SRE-VHF)
35	WP2Y	21	Wallops Island, Virginia (SRE-VHF)
36	WPSZ	19	Wallops Island, Virginia (SRE-VHF)

B. C-Band Tracking System

Index Number	Station Acronym	External Station ID	Description
62	ANTQ	911	Antigua, West Indies (FPQ-6)
51	ASCF	750	Ascension Island (FPS-16)
61	ASCQ	702	Ascension Island (FPQ-15)
60	AS2Q	104	Ascension Island
53	BDAQ	013	Bermuda (FPQ-6)
56	CALF	470	Vandenberg AFB, California

Table A-5. Station Indexes and Acronyms for 60-Byte Data (3 of 8)

Index Number	Station Acronym	External Station ID	Description
76	CALT	484	Vandenberg AFB, California (TPQ-18)
57	CA2F	490	Tranquillon Park, California
52	CNVF	650	Cape Canaveral, Florida (FPS-16)
80	GBIQ	419	Grand Bahama (FPQ-13)
78	GTKQ	511	Grand Turk, Bahama (TPQ-18)
53	HAWF	125	Makaha Ridge, Hawaii (FPS-16 meters)
65	KMRQ	696	Kwajalein (ALCOR)
77	KMRT	744	Kwajalein
73	KMRF	027	Kwajalein
71	KM2F	92	Kwajalein
66	KPTQ	681	Kaena Point, Hawaii (FPQ-14)
70	MLAQ	711	Merritt Island, Florida
67	PATQ	211	Patrick AFB, Florida (FPQ-6)
69	PA2Q	209	Patrick AFB, Florida
50	PPTF	500	Pillar Point, California
64	PPTQ	463	Pillar Point, California (FPQ-6)
58	WLPF	530	Wallops Island, Virginia
68	WLPQ	863	Wallops Island, Virginia (FPQ-6)
59	WL2F	520	Wallops Island, Virginia
C. Minitrack			
86	AGOM	08	Santiago, Chile
87	BURM	16	Johannesburg, Republic of South Africa
93	KRUM	92	Kourou, French Guiana
88	ORRM	21	Orroral, Australia
94	PREM	91	Pretoria, Republic of South Africa
89	QUIM	05	Quito, Ecuador
91	ULAM	19	Fairbanks, Alaska
92	WNKM	15	Winkfield, England

Table A-5. Station Indexes and Acronyms for 60-Byte Data (4 of 8)

Index Number	Station Acronym	External Station ID	Description
D. ATS-R Tracking System			
101	AMDR	57	Ahmedabad, India (14 meters)
102	AVER	47	Mojave, California (12 meters)
108	AV2R	66	Mojave, California (6.4.meters, H-D)
103	KASR	68	Kashima, Japan (30 meters, S-Y)
104	MADR	99	Madrid, Spain (TGS) (6.4 meters, H-D)
105	ROSR	58	Rosman, North Carolina (26 meters, 2)
106	RO2R	59	Rosman, North Carolina (Place + 26 meters, 2)
107	RO3R	60	Rosman, North Carolina (Place + 26 meters, 2)
109	YOKR	48	Yokosuka, Japan (12 meters, A-E)
E. ATS-R Ground Transponders			
TBD	ACNB	00	Ascension Island
TBD	AGOB	00	Santiago, Chile
TBD	AVEB	00	Mojave, California
TBD	BURB	00	Johannesburg, Republic of South Africa
TBD	GSFB	00	Greenbelt, Maryland
TBD	MADB	00	Madrid, Spain
TBD	ROSB	00	Rosman, North Carolina
130	ULAB	00	Fairbanks, Alaska
F. GRARR Tracking System (VHF)			
141	AGOV	27	Santiago, Chile (VHF)
149	AG2V	17	Santiago, Chile (VHF)
150	AG3V	13	Santiago, Chile (VHF)

Table A-5. Station Indexes and Acronyms for 60-Byte Data (5 of 8)

Index Number	Station Acronym	External Station ID	Description
F. (Cont'd)			
148	AG4V	52	Santiago, Chile (VHF)
151	AG5V	53	Santiago, Chile (VHF)
142	ORRV	35	Orroral, Australia (SANTAN)
143	OR2V	36	Orroral, Australia (SATAN + 26 meters)
144	ROSV	26	Rosman, North Carolina (VHF, SATAN)
145	RO2V	25	Rosman, North Carolina (VHF, SATAN + 26 meters)
147	ULAV	28	Fairbanks, Alaska (VHF)
G. GRARR Tracking System (S-Band)			
156	ROSG	261	Rosman, North Carolina (S-Band)
H. X-Y Angle Telemetry Tracking System			
1. 12 Meters			
166	AGO4	67	Santiago, Chile
171	BLT4	76	Greenbelt, Maryland
167	BUR4	65	Johannesburg, Republic of South Africa
168	QUI4	66	Quito, Ecuador
170	ULA4	64	Fairbanks, Alaska
2. 26 Meters			
176	ORRE	33	Orroral, Australia
177	ROSE	30	Rosman, North Carolina (#1)
178	RO2E	31	Rosman, North Carolina (#2)
179	ULAE	32	Fairbanks, Alaska

Table A-5. Station Indexes and Acronyms for 60-Byte Data (6 of 8)

Index Number	Station Acronym	External Station ID	Description
I.	Laser Tracking System		
200	HALL	78	Haleakala, Hawaii
199	MACL	62	Fort Davis, Texas
198	MLRL	25	Fort Davis, Texas
221	M01L	81	Mobile LASER 1
222	M02L	82	Mobile LASER 2
223	M03L	83	Mobile LASER 3
224	M04L	84	Mobile LASER 4
225	M05L	85	Mobile LASER 5
226	M06L	86	Mobile LASER 6
227	M07L	87	Mobile LASER 7
228	M08L	88	Mobile LASER 8
201	RAML	79	Florida LASER
202	STAL	80	STALAS/GSFC
J.	SAO Optical Tracking System (Baker-Nunn Camera)		
247	AREC	9027	Arequipa, Peru
248	CLCC	9124	Cold Lake, Alberta, Canada
249	DIOC	9030	Dionysos, Greece
250	DODC	9025	Dodaira, Japan
251	EAFC	9113	Edwards AFB, California
252	HOPC	9021	Mount Hopkins, Arizona
253	MTJC	9119	Mount John, New Zealand
254	NAIC	9006	Naini Tal, India
255	NATC	9039	Natal, Brazil
256	ORRC	9043	Orroral, Australia
257	PUSC	9125	Pulmosan, Korea
258	SAFC	9004	San Fernando, Spain
259	SANC	9120	San Vito, Italy
260	SMCC	9122	St. Margaret, Canada

Table A-5. Station Indexes and Acronyms for 60-Byte Data (7 of 8)

Index Number	Station Acronym	External Station ID	Description
K. DSN Mark IVA Tracker			
121	DS12	12	Goldstone, California (34 meter, std)
122	DS14	14	Goldstone, California (64 meter)
123	DS15	15	Goldstone, California (34 meter, hef)
124	DS42	42	Canberra, Australia (34 meter, std)
125	DS43	43	Canberra, Australia (64 meter)
126	DS45	45	Canberra, Australia (34 meter, hef)
127	DS61	61	Madrid, Spain (34 meter, std)
128	DS63	63	Madrid, Spain (70 meter)
129	DS65	65	Madrid, Spain (34 meter, hef)
L. SAO and Foreign Cooperative Laser Tracking System			
207	AREL	7907	Arequipa, Peru
208	DIOL	7940	Dionysos, Greece
209	DODL	7935	Dodaira, Japan
210	GRAL	7842	Grasse, France
203	GRZL	7839	Graz, Austria
205	GR2L	7835	Grasse, France
211	HLWL	7801	Helwan, Egypt
219	HL2L	7831	Helwan, Egypt
212	HOPL	7921	Mount Hopkins, Arizona
213	KOOL	7833	Kootwijk, Netherlands
218	METL	7805	Metsahovi, Finland
214	NATL	7929	Natal, Brazil
215	ORRL	7943	Orroral, Australia
216	SAFL	7804	San Fernando, Spain
204	SA2L	7824	San Fernando, Spain

Table A-5. Station Indexes and Acronyms for 60-Byte Data (8 of 8)

Index Number[1]	Ground Transponder Acronym		Description
L. (Cont'd)			
206	SIML	7838	Shimosato, Japan
217	WE2L	7834	Wettzell, Germany
M. SGLS			
301 - 399			Reserved for SGLS trackers
N. TDRSS			
161	WHSK	09	White Sands, New Mexico
162	WH2K	10	White Sands, New Mexico
163	WH3K	11	White Sands, New Mexico
O. TDRSS Ground Transponders			
403	ACNJ		Ascension Island
410	AC2J		Ascension Island
404	ALSJ		Alice Springs, N. T., Australia
405	AMSJ		American Samoa, Tutuila
407	BLTJ		Greenbelt, Maryland
451	JSCJ		Johnson Space Center, Texas
406	MILJ		Merrit Island, Florida
401	WHSJ		White Sands, New Mexico
402	WH2J		White Sands, New Mexico

[1] Although ground transponders are not considered to be trackers and, therefore, have no external tracker numbers assigned to them, the ground transponders are assigned specific index or catalog numbers that are treated in the same manner as tracker 60-byte index numbers for the purpose of automatic retrieval of geodetic information by the Goddard Trajectory Determination System (GTDS). The index number for each TDRS ground transponder is equal to 400 plus the value appearing in bits 3 through 8 of byte 2, word 9, of TDRS 60-byte records containing ground relay observations.

APPENDIX B - CENTRAL BODY INDEXES

Index	Central Body
1	Earth
2	Moon
3	Sun
4	Mars
5	Jupiter
6	Saturn
7	Uranus
8	Neptune
9	Pluto
10	Mercury
11	Venus

APPENDIX C - GTDS FORTRAN REFERENCE NUMBERS

FRN	Description
0	Permanent dummy for suppression of output in propagator mode
1	Report Index File
2	Atmospheric Density Models File
3	Impulsive Maneuvers File
4	Astrodynamic Constants File
5	Card option input
6	Printer output
7	Punched output
8	Earth Potential Fields File
9	Lunar Potential Fields File
10	Integration Coefficients File
11	Flight Sectioning Models File
12	Temporary data set containing card input when in cathode ray tube (CRT) input mode
13	Error Messages File
14	Solar/Lunar/Planetary (SLP) 1950 Ephemeris File
15	Observations card input
16	Data simulation Summary Working File
17	Working Observations File
18	SLP Working File
19	Direct ORBIT File with partial derivatives
20	Direct ORBIT File without partial derivatives
21	Sequential ORBIT File with partial derivative
22	Sequential ORBIT File without partial derivatives
23	Collective Error Message File for scope or GUI
24	Primary ORB1/EPHEM output file (This integer location can contain FORTRAN Reference Numbers (FRN) 24, 81, 83, 85, or 87, depending on which file is being built.)
25	GTDS Permanent Elements File
26	24-Hour Hold Elements File
27	Tracking Station Geodetics File

FRN	Description
28	Data set containing the satellite ephemeris to be be transmitted to scope
29	GTDS observation tape
30	DODS observation tape
31	GTDS observation disk
32	60-Byte partial batch file
33	SLP tape
34	JPL tape (DE-19 format only)
35	Data set containing integration statistics for scope display
36	Data set containing final orbit generator report for scope display
37	Observations Sort File
38	Time Conversion Coefficients File
39	Ionospheric Refraction Generalized Coefficients File
40	Permanent files report to be scanned on the scope
41	Temporary data set containing starter arrays
42	Observations residuals to be transmitted to scope
43	Solve-for parameters to be transmitted to scope
44	Elements to be transmitted to scope
45	Scratch ORBIT File
46	GTDS Observation Save File
47	URC Report File
48	Scratch Potential Fields File
49	DC Program Summary Report for the scope
50	Tracking Data Acquisition Summary Report
51	Standard DC Program Elements Report for teletype transmission
52	Data simulation input Definitive Orbit Determination System (DODS) tape
53	Orbit Determination Files Report for Computer-Assisted Interactive Resource Scheduling (CAIRS)
54	Chebyshev ephemeris tape for PDP-11
55	Graphics device for the interactive mode
56	Request file

FRN	Description
57	Block COMMON Nominal Values File
58	Ionospheric Refraction Working File (NOVAK file)
59	Solar Flux Permanent File
60	GTDS Accounting Information File
61	Residual Edit Working File
62	Tracking Data Validation Extract File
63	ODS summary for scope Flight Director Report
64	Statistical Output Report (SOR) Data Subset Extract File
65	Intermediate Ionospheric Refraction Coefficients Working File
66	Intermediate Ionospheric Refraction Coefficients Working File - save unit
67	Real-Time Ionospheric Data File
68	Tropospheric (scale height and refractivity) Data Permanent File (BENT model)
69	Direct-access file containing scope prompting messages
70	User-supplied input deck for prompting mode
71	Permanent satellite ORBIT File for a TDRS relay
72	Permanent satellite ORBIT File for a TDRS relay
73	Permanent satellite ORBIT File for a TDRS relay
74	Graphics Interrupt File
75	Jacchia-Roberts Atmosphere File
76	GMAN output file (mass/thrust)
77	Temporary data set to be used for the ORB1/EPHEM File concentric sort
78	SLP True-of-Date (TOD) Ephemeris File
79	Flight Sectioning File
80	Target satellite scratch ORBIT File
81	Second ORB1/EPHEM File
82	Second sequential ORBIT File with partial derivatives (for COMPARE Program)
83	Third ORB1/EPHEM File

FRN	Description
84	Second sequential ORBIT File without partial derivatives (for Ephemeris Comparison (COMPARE) Program)
85	Fourth ORB1/EPHEM File
86	Second DA ORBIT File with partial derivatives (for COMPARE Program)
87	Fifth ORB1/EPHEM File
88	Second DA ORBIT File without partial derivatives (for COMPARE Program)
89	Output file when subtasked under GUI
90	Input file (keyword cards) in either subtasked mode
91	60-byte format Generalized Data Handler (GDH) observations tape input
92	Error Analysis Summary Report for the printer
93	Error Analysis data set
94	Optical aspect input data
95	DC SOR File
96	60-byte format (GDH) observation data base input
97	Scratch ORBIT File for a TDRS relay (1)
98	Scratch ORBIT File for a TDRS relay (2)
99	Scratch ORBIT File for a TDRS relay (3)

APPENDIX D - DATA MODELS

A. Earth Potential Field Models

1 = SAO 1969 Standard Earth

2 = Earth Potential for Manned Flight Computations (EPMFC)

3 = Goddard Space Flight Center (GSFC) Earth Model (GEM 1)

4 = GSFC Earth Model (GEM 7)

5 = GSFC Earth Model (GEM 9)

B. Lunar Potential Field Models

1 = Lunar Potential Model (Lunar Orbiter 4)

2 = Lunar Potential Adopted Reference Set

3 = Lunar Potential for Manned Flight Computations

4 = Jet Propulsion Laboratory (JPL) 15 x 8 Model

C. Physical (Astrodynamic) Constants Models

1 = Current Goddard Trajectory Determination System (GTDS) Physical Constants

D. Flight Sectioning Models

1 = GEOS (Fixed-Step-Restart)

2 = IMP-4, Backwards IMP-4, Apollo (2-Sections), Maneuver about Moon

3 = Drag

4 = Harmonics

5 = Solar Radiation

6 = Full Force

E. Atmospheric Density Models

1 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 65

2 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 75

3 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 100

4 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 125

5 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 150

6 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 175

7 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 200

8 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 225

9 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 250

10 = 1964 Harris-Priester Atmosphere (Min-Max)
0-1000 kilometers F = 275

APPENDIX E - REQUIRED AND OPTIONAL PROGRAM INPUT

Mandatory keyword cards used in GTDS are presented in Table E-1. Required and optional subdecks are shown in Table E-2.

Table E-1. Mandatory Cards for Each Program

PROGRAM NAME	MANDATORY KEYWORDS
EPHEMERIS GENERATION	ORBTYPE OUTPUT EPOCH* ELEMENT1* ELEMENT2*
DIFFERENTIAL CORRECTION	ELEMENT1* ELEMENT2* EPOCH* ORBTYPE OBSINPUT
EARLY ORBIT DETERMINATION	EPOCH OBSINPUT OBSNUME** TYPE
DATA SIMULATION	NONE
ERROR ANALYSIS	NONE
EPHEMERIS COMPARISON	NONE
DATA MANAGEMENT	NONE
PERMANENT FILE REPORT GENERATION	NONE

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*THESE KEYWORDS ARE MANDATORY UNLESS THE EPOCH AND ELEMENTS ARE TO BE PASSED THROUGH BLOCK COMMON OR ARE TO BE READ FROM A STORED FILE, IN WHICH CASE A WORKELS KEYWORD CARD MUST THEN BE SPECIFIED IN A DATA MANAGEMENT SUBDECK.

**THIS KEYWORD IS MANDATORY UNLESS AN AUTOMATIC EARLY ORBIT DETERMINATION METHOD IS SELECTED IN TYPE KEYWORD CARD.

Table E-2. Required and Optional Subdeck(s) for Each Program

PROGRAM	REQUIRED SUBDECKS	OPTIONAL SUBDECKS
EPHEMERIS GENERATION (EPHEM)	NONE	OGOPT DCOPT DMOPT
DIFFERENTIAL CORRECTION (DC)	NONE	OGOPT DCOPT DMOPT TDROPT
EARLY ORBIT DETERMINATION (EQARLYORB)	NONE	OGOPT DCOPT DMOPT EOOPT
DATA SIMULATION (DATASIM)	DMOPT (MUST INDICATE STATIONS)	OGOPT DCOPT
ERROR ANALYSIS (ANALYSIS)	DCOPT (ORBIT FILE) DMOPT (STATIONS)	NONE
EPHEMERIS COMPARISON (COMPARE)	COMPOPT	NONE
DATA MANAGEMENT (DATAMGT)	DMOPT	NONE
PERMANENT FILE REPORT GENERATION (FILERPT)	PFROPT	NONE

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APPENDIX F - KEYWORD CARD FUNCTIONAL DESCRIPTION AND CROSS-REFERENCE

This appendix contains two lists to assist the user in determining the function of each keyword card and which keyword card is used for a particular function. The Goddard Trajectory Determination System (GTDS) Keyword Card Functional Descriptions (Section F.1) alphabetically list all keyword cards, the function of each card, the programs for which the keyword cards apply, and subdecks in which the keyword cards are included. Subdeck identifier keyword cards are also included, with a list of all keyword cards valid for the given subdeck. The Keyword Cross-Reference (Section F.2) alphabetically lists by function the switches or variables the user might want to modify, along with the keywords used to do the modification.

F.1 GTDS KEYWORD CARD FUNCTIONAL DESCRIPTIONS

Keyword	Function	Program	Subdeck
Aƀƀƀ****	Sets edit acceptance criteria (the asterisks represent the station acronym)	DC DATAMGT	DMOPT DCOPT
ACCREJ	Activates observation editing capability	DC DATAMGT	DMOPT DCOPT
APOFOCAL	Defines sectioning indicator to cross at the apofocal point	EPHEM DC	OGOPT
ATMOSDEN	Reads atmospheric density table in GTDS or DODS format and specifies the density model	EPHEM DC	OGOPT
ATMOSEDT	Sets atmospheric editing limits	DC	DCOPT
ATMOSRPT	Specifies a report of Atmospheric Density Models File	FILERPT EPHEM	PFROPT

Keyword	Function	Program	Subdeck
ATTANG1	Sets coefficients of a function that describes the right ascension or yaw angle of the spin axis	EPHEM DC DATASIM	OGOPT
ATTANG2	Sets coefficients of a function that describes the declination or pitch angle of the spin axis	EPHEM DC DATASIM	OGOPT
ATTANG3	Sets coefficients of a function that describes the roll angle	EPHEM DC	OGOPT
ATTPAR	Specifies number of attitude coefficients to be solved for	EPHEM DC	OGOPT
AUTOFORC	Allows inclusion of resonance potential	EPHEM DC	OGOPT
AVERAGE	Sets Variation of Parameters numerical averaging	EPHEM DC	OGOPT
BDROTATE	Sets rotation rates of the bodies	EPHEM DC DATASIM	OGOPT
BODYRAD	Sets equatorial radii for the specified bodies	EPHEM DC DATASIM	OGOPT
BURNFSF	Sets the option of orbit propagation through burns using information from FSF	EPHEM	OGOPT
CBODY	Sets integration central body by flight section	EPHEM DC	OGOPT
CHWT****	Sets input observation noise standard deviation for observations in 60-byte format when the SOR is requested	DC	DMOPT
CMCORR	Sets spacecraft antenna offsets	DC	OGOPT
CMPEPHEM	Specifies comparison start time, comparison end time, comparison interval, and input files	COMPARE	COMPOPT
CMPFILES	Selects FORTRAN unit numbers of two EPHEM Files to be compared	COMPARE	COMPOPT

Keyword	Function	Program	Subdeck
CMPPLOT	Sets COMPARE Program printer plot options	COMPARE	COMPOPT
CMPTITLE	Specifies number of title cards for COMPARE Program printer plots	COMPARE	COMPOPT
CNM	Sets $C_{n,m}$ harmonics coefficients options and values	EPHEM DC EARLYORB ANALYSIS	OGOPT
COMPOPT	Initiates Program subdeck processing	COMPARE	Subdeck identifier
CONSIDER	Invokes the consider mode	DC ANALYSIS	DCOPT
CONSTRPT	Specifies a report of the Astrodynamic Constants File	FILERPT EPHEM	PFROPT
CONTROL	Initiates the input processor in a GTDS program run	EPHEM DC EARLYORB DATASIM ANALYSIS COMPARE DATAMGT FILERPT	Mandatory
CONVERG	Sets DC iteration control	DC	DCOPT
COVARNC	Sets upper triangle of the a priori state covariance matrix	EPHEM DC ANALYSIS	OGOPT
CWEIGHT	Sets weighting factor constants for observation handling	DC ANALYSIS	DCOPT
Dbbb****	Sets edit deletion criteria (the asterisks represent the station acronym)	DC	DMOPT DCOPT
DCFDR	Specifies that the Orbital Elements Report contain osculating or Brouwer mean elements	DC	DCOPT
DCOPT	Initiates DC subdeck processing	DC EARLYORB DATASIM ANALYSIS	Subdeck identifier

Keyword	Function	Program	Subdeck
DECLVAR	Sets the a priori standard deviations for declination or pitch coefficient	DC	OGOPT
DISTCB	Sets distance from the current central body at which sectioning is to occur	EPHEM DC	OGOPT
DISTNCB	Sets distance from the next central body at which sectioning is to occur	EPHEM DC	OGOPT
DMOPT	Initiates Data Management Subdeck processing	EPHEM DC EARLYORB DATASIM ANALYSIS DATAMGT	Subdeck identi-fier
DRAG	Sets drag force model option for each section	EPHEM DC	OGOPT
DRAGCOF	Sets polynomial coef-ficient of ρ_1	DC EPHEM ANALYSIS	OGOPT
DRAGPAR	Updates drag parameters and sets the drag partial derivatives switch	EPHEM DC ANALYSIS	OGOPT
DRAGPOLY	Sets number of ρ_1 coefficients for each section	DC EPHEM ANALYSIS	OGOPT
DSPEA1	Sets simulated data track-ing schedule	DATASIM ANALYSIS	DCOPT
DSPEA2	Specifies input ephemeris file and end simulation timespan	DATASIM ANALYSIS	DCOPT
DSPEA3	Specifies various DATASIM Program output options	DATASIM	DCOPT
EDIT	Sets observation edit parameters	DC	DCOPT
ELEMENT1	Identifies coordinate system and reference cen-tral body of the initial state and sets first three components of state	EPHEM DC	Manda-tory

Keyword	Function	Program	Subdeck
ELEMENT2	Sets second three components of the initial state	EPHEM DC	Mandatory
ELLMODEL	Defines ellipsoid model for conversion of tracking station coordinates	DATASIM DC	DCOPT
ELSRPT	Specifies a report of the GTDS Permanent Elements File	FILERPT EPHEM	PFROPT
ELS24RPT	Specifies a report of the GTDS 24-Hour Hold Elements File	FILERPT EPHEM	PFROPT
END	Identifies the end of a subdeck	EPHEM DC EARLYORB DATASIM ANALYSIS COMPARE FILERPT DATAMGT	All
EOINTRVL	Sets minimum time difference between observations	EARLYORB	Mandatory
EPHMERGE	Specifies ephemeris merge criteria	COMPARE	COMPOPT
EPHQLCRT	Specifies printout of selected data points from EPHEM or ORB1 Files	EPHEM DC	OGOPT
EPOCH	Specifies the epoch of the initial conditions	EPHEM DC EARLYORB	Mandatory
EPOTRPT	Specifies a report of the Earth Potential Fields File	FILERPT EPHEM	PFROPT
FIN	Indicates end of a program input deck	EPHEM DC EARLYORB DATASIM ANALYSIS COMPARE DATAMGT FILERPT	Mandatory
FLATCOEF	Sets inverse values of the flattening coefficients	EPHEM DC DATASIM	OGOPT

Keyword	Function	Program	Subdeck
GEODRPT	Specifies a report of the Tracking Station Geodetics File	FILERPT EPHEM	PFROPT
GMCON	Sets gravitational constants for specified bodies	EPHEM DC	OGOPT
HARMONIC	Reads harmonic table	EPHEM DC EARLYORB	OGOPT
HISTPLOT	Sets element plot options	EPHEM COMPARE	OGOPT COMPOPT
HSTSCALE	Sets scales for element plots	EPHEM COMPARE	OGOPT COMPOPT
IMPACT	Enables impact modeling	EPHEM	OGOPT
IMPULSE	Sets impulsive maneuver velocity increments	EPHEM DC	OGOPT
INTCRPT	Specifies a report of the Integration Coefficients File	FILERPT EPHEM	PFROPT
INTEG	Sets numerical integration parameters	EPHEM DC	OGOPT
INTEROUT	Requests intermediate output from selected subroutines	EPHEM DC DATASIM ANALYSIS	OGOPT DCOPT
INTMODE	Sets integration step size control mode	EPHEM DC	OGOPT
LIFETIME	Sets orbit generator in the lifetime study mode	EPHEM	DMOPT
LNDPAR	Sets data for processing landmark observations	DC	OGOPT
LOWBOUND	Sets step size control lower truncation error bound	EPHEM DC	OGOPT
LPOTRPT	Specifies a report of the Lunar Potential Fields File	FILERPT EPHEM	PFROPT
MANMASS	Sets the satellite mass required to compute impulsive maneuvers	EPHEM DC	OGOPT
MANTIME	Sets time of impulsive maneuver	EPHEM DC	OGOPT

Keyword	Function	Program	Subdeck
MANURPT	Specifies a report of the Impulsive Maneuvers File	FILERPT EPHEM	PFROPT
MAPTIMES	Allows mapping of the epoch covariance matrix to other times	ANALYSIS	DCOPT
MASS	Sets the spacecraft mass by flight section	EPHEM DC	OGOPT
MASSRATE	Sets the spacecraft mass rate by flight section	EPHEM DC	OGOPT
MAXDEGEQ	Sets maximum degree to be used in evaluating the nonspherical potential of the central body for the equations of motion	EPHEM DC	OGOPT
MAXDEGVE	Sets maximum degrees to be used in evaluating the nonspherical potential of the central body for the variational equations	EPHEM DC	OGOPT
MAXOBS	Sets maximum number of observations in the observation working file	DC DATAMGT	DMOPT
MAXORDEQ	Sets maximum order to be used in evaluating the nonspherical potential of the central body for the equations of motion	EPHEM DC	OGOPT
MAXORDVE	Sets maximum order to be used in evaluating the nonspherical potential of the central body for the variational equations	EPHEM DC	OGOPT
MAXSECT	Sets number of flight sections	EPHEM DC	OGOPT
MEANEL	Sets numerical osculating-to-mean element conversion options	EPHEM DC	OGOPT
MIXPAIR	Indicates mixing of a pair of SOR categories as a single SOR category	DC	DMOPT
MODDC	Indicates that the Marquardt algorithm will be used in the DC Program	DC	DCOPT

Keyword	Function	Program	Subdeck
NCBODY	Sets noncentral bodies for each section	EPHEM DC	OGOPT
NOIMIN	Sets minimum valid points to perform noise analysis	DC	DMOPT
NOIS****	Sets noise determination criteria	DC	DMOPT
NOMBOUND	Sets nominal truncation error bound for step size control	EPHEM DC	OGOPT
NPQPAR	Sets Brouwer-Lyddane $N_{p,q}$ coefficient values	EPHEM DC	OGOPT
OASENSOR	Sets attitude sensor data values and options	DC DATASIM	DCOPT
OBSCORR	Sets observation correction parameters	DC DATASIM ANALYSIS	DCOPT
OBSDEV	Sets input observation noise standard deviation for observations in 60-byte format when SOR is not requested and for observations in 100-byte format	DC ANALYSIS DATASIM	DMOPT
OBSINPUT	Specifies observations input sources	DC EARLYORB	Mandatory
OBSNUME	Selects observation numbers and types for the EARLYORB Program	EARLYORB	Mandatory
OGOPT	Initiates orbit generator subdeck processing	EPHEM DC DATASIM EARLYORB ANALYSIS	Subdeck identifier
ORBTYPE	Selects orbit generator type and sets certain related parameters	EPHEM DC	Mandatory
OUTBODY	Sets additional optional output reference bodies by flight section	EPHEM DC	OGOPT
OUTCOORD	Sets output coordinate system orientation by flight sections	EPHEM	OGOPT

Keyword	Function	Program	Subdeck
OUTOPT	Selects ephemeris file output	EPHEM DC	OGOPT
OUTPART	Sets output for state partial derivatives by flight section	EPHEM	OGOPT
OUTPUT	Specifies orbit generator printer output	EPHEM	Manda-tory
OUTTYPE	Sets printer output reference system by flight section	EPHEM	OGOPT
PARTRTMS	Specifies options for the Partial Tracking Report	ANALYSIS	DCOPT
PASSTIME	Defines a pass for pass-dependent biases	DC	DCOPT
PFROPT	Initiates Permanent File Report subdeck processing	FILERPT EPHEM	Subdeck identi-fier
PICBIAS	Sets landmark camera/ picture biases options	DC	OGOPT
POLAR	Sets polar motion option switch for each flight section	EPHEM DC	OGOPT
POTFIELD	Indicates if retrieval of potential field data is required	EPHEM DC	OGOPT
PRINTOUT	Sets Observation Residual Report frequency	DC	DCOPT
RAMB****	Keyword to override small range ambiguities	DC	DCOPT
RAMBOPT	Sets range ambiguity computation option	DC	DCOPT
RAPRIME	Sets the right ascension of the prime meridian of the specified body	EPHEM	OGOPT
RATIME	Sets RCA sectioning switch for a central body	EPHEM DC	OGOPT
RCACB	Sets RCA sectioning switch for a central body	EPHEM DC	OGOPT
RCANCB	Sets RCA for the next central body sectioning condition	EPHEM DC	OGOPT

Keyword	Function	Program	Subdeck
RELAYID	Specifies relay satellite identification number	DATASIM	DMOPT
RESTART	Sets the integration starter method	EPHEM DC	OGOPT
ROLLVAR	Sets the a priori standard deviations of roll coefficients	DC	OGOPT
RTASCVAR	Sets the a priori standard deviation of right ascension or yaw coefficients	DC	OGOPT
RTSATID	Specifies all satellite IDs for which partial batch date are to be requested	DC EARLYORB	DMOPT
RTPARAMS	Specifies the partial batch request parameters	DC EARLYORB	DMOPT
RSTA****	Specifies the tracking station for which partial batch data are to be requested	DC EARLYORB	DMOPT
RSYS****	Specifies the tracking system for which partial batch data are to be requested	DC EARLYORB	DMOPT
SAMPLRTE	Sets edit acceptance criteria by time	DC	DMOPT
SAVE	Specifies the option to save the Observations Working File	DC	DCOPT
SATGROUP	Specifies satellite grouping option in the Data Management subsection	DC	DMOPT
SCAREA	Sets the spacecraft cross-sectional area by flight section	EPHEM DC	OGOPT
SCPARAM	Sets spacecraft parameters (area, mass, and radius)	EPHEM DC ANALYSIS	OGOPT
SCPARAM2	Sets cylindrical spacecraft parameters and paddle configuration	EPHEM DC	OGOPT
SECTRPT	Specifies a report of the Flight Sectioning Models File	FILERPT EPHEM	PFROPT

Keyword	Function	Program	Subdeck
SELOUT	Sets generation of SOR	DC	DMOPT
SHELLRAD	Sets radial distance and step size for the integrator when using the shell mode	EPHEM DC	OGOPT
SLPBODY	Sets central and non-central bodies for generating the SLP Ephemeris Working File	EPHEM DC DATASIM DATAMGT ANALYSIS	DMOPT
SLPCOORD	Specifies SLP ephemeris coordinate system reference	EPHEM DC DATASIM DATAMGT ANALYSIS	DMOPT
SLPDEG	Sets degree of curvefit for SLP bodies and rotation matrixes	EPHEM DC DATASIM DATAMGT ANALYSIS	DMOPT
SLPELRPT	Specifies a report of the SLP Ephemeris File by body	FILERPT EPHEM	PFROPT
SLPFILE	Indicates source of SLP data to be used in creating SLP Working File	EPHEM DC DATASIM DATAMGT ANALYSIS	DMOPT
SLPRPT	Specifies a report of the SLP Ephemeris File by matrix order	FILERPT EPHEM	PFROPT
SNM	Sets $S_{n,m}$ harmonic coefficients options and values	EPHEM DC EARLYORB ANALYSIS	OGOPT
SOLRAD	Sets the force model solar radiation switch for each section	EPHEM DC ANALYSIS	OGOPT
SOLRDPAR	Sets solar radiation parameter and sets solar radiation partial derivatives switch	EPHEM DC ANALYSIS	OGOPT

Keyword	Function	Program	Subdeck
SORINPUT	Sets SOR editing parameters	DC	DMOPT
SORVALID	Sets data validity check overrides	DC	DMOPT
SPHERE	Sets sphere of influence for the planetary bodies	EPHEM DC	OGOPT
SPHINF	Sets the sectioning parameter to cross at the point of change in the sphere of influence	EPHEM DC	OGOPT
SSCOVAR	Sets the upper triangle of the a priori state covariance matrix for a relay satellite	DC	DCOPT
SSELEM1	Identifies coordinate system and solve status of the initial state of the relay satellite and sets first three components of the state	DC	DCOPT
SSELEM2	Sets second three components of the initial state of the relay satellite	DC	DCOPT
SSEPOCH	Sets the epoch for the relay satellite	DC	DCOPT
SSOPT	Sets orbit generator type and spacecraft parameter for the relay satellite	DC	DCOPT
SSTSIM	Sets parameters used in simulating SST data	DATASIM	DCOPT
STATEPAR	Sets state vector partial derivatives switch to compute state partial derivatives or to indicate state solve-for parameters	EPHEM DC ANALYSIS	OGOPT
STATETAB	Sets required state parameters components for computation of partial derivatives and/or solve-for state parameters	EPHEM DC ANALYSIS	OGOPT
STEPSIZE	Sets integration step size by flight section	EPHEM DC	OGOPT

Keyword	Function	Program	Subdeck
TDRBATCH	Sets TDRSS SOR batching criteria overrides	DC	TDROPT
TDRCOV1	Sets the a priori covariance matrix for a TDRS relay	DC	TDROPT
TDRCOV2	Sets the a priori covariance matrix for a TDRS relay	DC	TDROPT
TDRCOV3	Sets a priori covariance matrix for a TDRS relay	DC	TDROPT
TDRELEM1	Sets first three components of the initial state vector for a TDRS relay	DC	TDROPT
TDRELEM2	Sets second three components of the initial state vector for a TDRS relay	DC	TDROPT
TDREPOCH	Sets the epoch of a TDRS relay	DC	TDROPT
TDRFILES	Specifies creation of output ORBIT Files for a TDRS relay	DC	TDROPT
TDRID	Sets TDRS relay identifier and international designator	DC	TDROPT
TDRMODEQ	Sets order and degree of potential used in the equations of motion for a TDRS relay	DC	TDROPT
TDRMODVE	Sets order and degree of potential used in the equations of motion for a TDRS relay	DC	TDROPT
TDROBSIN	Sets TDRS relay observation data input override flags	DC DATAMGT	TDROPT
TDROPT	Specifies processing of the TDROPT subdeck	DC	Subdeck identifier
TDRORB	Sets orbit generator and spacecraft parameters for a TDRS relay	DC	TDROPT

Keyword	Function	Program	Subdeck
TDRREFLC	Sets solar reflectivity for a TDRS relay	DC	TDROPT
TDRSCPRM	Sets spacecraft parameters	DC	TDROPT
TDRSTEP	Sets integration step size for a TDRS relay	DC	TDROPT
TDRSTPAR	Sets state solve-for parameters for a TDRS relay	DC	TDROPT
TDRWKELS	Specifies retrieval of initial state elements for a TDRS relay	DC	TDROPT
TDRXPNDR	Sets satellite transponder delays	DC	TDROPT
THRSTCOF	Sets polynomial coefficients of thrust to be used by flight section	EPHEM DC	OGOPT
THRSTPAR	Sets number of polynomial coefficients of thrust to be solved for by flight section	EPHEM DC	OGOPT
THRSTVAR	Sets variance of thrust accelerations, vehicle right ascension and declination	EPHEM DC	OGOPT
THRUST	Sets finite thrust option for each flight section	EPHEM DC	OGOPT
THSHORT1	Sets FSF output option, maximum number of iterations, maximum freeze number, and maximum tolerance in position	THMODEL	OGOPT
THSHORT2	Sets user's output option, matrix option, and maximum tolerance in velocity	THMODEL	OGOPT
THSHORT3	Sets changes in pitch, yaw, and thrust acceleration for the correction matrix	THMODEL	OGOPT
THSHORT4	Sets changes in pitch rate, yaw rate, and thrust acceleration rate for the correction matrix	THMODEL	OGOPT

Keyword	Function	Program	Subdeck
THSHORT5	Sets maneuver number, record numbers, time of ignition and burnout, and integration step size	THMODEL	OGOPT
THSOFNO	Sets thrust solve-for flags	DC EPHEM	OGOPT
THTAB1	First table definition (GMAN output)	DC EPHEM	OGOPT
THTAB2	Second table definition (GMAN output)	DC EPHEM	OGOPT
TIMES	Sets run reference date and EPHEM Program print start time	EPHEM	OGOPT
TIMREG	Sets section-dependent time regularization constant of the spacecraft radius	EPHEM DC	OGOPT
TIMREGDV	Sets section-dependent time regularization step size constant	EPHEM DC	OGOPT
TITLE	Sets GTDS run, atmospheric density, Earth potential, lunar potential, or run title	EPHEM DC DATASIM ANALYSIS	OGOPT
TOF	Sets time of flight at which sectioning is to occur	EPHEM DC	OGOPT
TOLER	Sets integration tolerances to be used for all flight sections	EPHEM DC	OGOPT
TRACKELV	Sets minimum allowable elevation angle	DC DATASIM ANALYSIS	DCOPT
TRNDLY	Sets station transponder delay table	DC DATASIM	DCOPT
TWOBODY	Sets two-body option in the force model for each section	EPHEM DC	OGOPT
TYPE	Selects method and parameter estimates for EARLYORB Program computation	EARLYORB	Mandatory

Keyword	Function	Program	Subdeck
UPPBOUND	Sets upper truncation error bound by flight section	EPHEM DC	OGOPT
VAREPHEM	Sets the time and height intervals between data points of variable-step EPHEM Files	DC EPHEM	OGOPT
WORKATM	Builds the Atmospheric Density Working File from the Astrodynamic Constants File	EPHEM DC DATAMGT	DMOPT
WORKCON	Builds the Astrodynamic Constants Working File from the Astrodynamic Constants File	EPHEM DC DATAMGT	DMOPT
WORKELS	Builds the element working file	EPHEM DATAMGT	DMOPT
WORKGEO	Builds the Station Geodetics Working File	EARLYORB ANALYSIS DATAMGT	DMOPT
WORKINT	Builds the Integration Coefficients Working File	EPHEM DC DATAMGT	DMOPT
WORKIONO	Builds the Ionospheric Refraction Working File	EPHEM DC DATASIM DATAMGT ANALYSIS	DMOPT
WORKMAN	Builds the Impulsive Maneuvers Working File	EPHEM DC DATAMGT	DMOPT
WORKOBS	Builds the Observations Working File	DATAMGT	DMOPT
WORKSECT	Builds the Flight Sectioning Working File	EPHEM DC DATAMGT	DMOPT
WORKTCOR	Sets flag for retrieval of data from Time Conversion Coefficients File	EPHEM DC DATAMGT	DMOPT

Keyword	Function	Program	Subdeck
/*******1	Station Card 1 - defines the station type and position (asterisks represent the station name)	DC EARLYORB DATASIM ANALYSIS DATAMGT	DCOPT DMOPT
/*******2	Station Card 2 - defines station-dependent data (asterisks represent station name)	DC EARLYORB DATASIM ANALYSIS DATAMGT	DCOPT DMOPT
/*******3	Station Card 3 - defines observation types for DC residual plots (asterisks represent station name)	DC	DCOPT
/*******4	Station Card 4- defines the standard deviation of station position when solving for station position (asterisks represent station name)	DC ANALYSIS	DCOPT
/*******5	Station Card 5 - defines station bias information (asterisks represent station name)	DC DATASIM ANALYSIS	DCOPT
/*******6	Station Card 6 - defines observation corrections for a specified station (asterisks represent station name)	DC DATASIM ANALYSIS	DCOPT
/*******7	Station Card 7 - defines miscellaneous schedule data (asterisks represent station name)	DATASIM ANALYSIS	DCOPT
/*******8	Station Card 8 - defines observation type and station error (asterisks represent the station name)	DATASIM ANALYSIS	DCOPT
/*******9	Station Card 9 - defines tracking interval (asterisks represent station name)	DATASIM ANALYSIS	DCOPT

F.2 KEYWORD CROSS-REFERENCE

Function	Keyword
Accept observations	Abbb****
Accept/reject observations	ACCREJ
Analytical partial derivatives	STATEPAR
Angle phi for DODS unknowns	STATEPAR
Antenna offset correction	CMCORR
Apofocal point for sectioning	APOFOCAL
Area of spacecraft	SCPARAM
Area of relay spacecraft	SSOPT
Astrodynamic Constants Permanent File Report	CONSTRPT
Astrodynamic Constants Working File	WORKCON
Atmospheric density model section	ATMOSDEN
Atmospheric Density Permanent File Report	ATMOSRPT
Atmospheric density table	ATMOSDEN
Atmospheric Density Working File	WORKATM
Atmospheric editing limits	ATMOSEDT
Attitude angles	ATTANG1 ATTANG2 ATTANG3
Attitude sensor data value and options	OASENSOR
Batching criteria for SOR	SELOUT TDRBATCH MIXPAIR
Bias pass	PASSTIME
Bodies, central and noncentral for SLP ephemeris	SLPBODY
Body, central	CBODY ELEMENT1 SLPBODY
Body, mean equatorial radius	BODYRAD
Body, noncentral	NCBODY SLPBODY
Body, output reference	OUTBODY
Body rotation rate	BDROTATE
Brouwer drag coefficients	NPQPAR

Function	Keyword
Central body, initial conditions	ELEMENT1
Central body, integration	CBODY
Central body, SLP ephemeris	SLPBODY
Closest approach to central body	RCACB
Closest approach to noncentral body	RCANCB
$C_{n,m}$ harmonic coefficients	CNM HARMONIC
$C_{n,m}$ partial derivatives, standard deviations	CNM
Coefficients, harmonic	HARMONIC CNM SNM
Coefficients, integration	WORKINT
Coefficients, inverse of flattening	FLATCOEF
Coefficients of thrust	THRSTCOF THRSTPAR
Comparison, ephemeris files	CMPEPHEM
Comparison interval	CMPEPHEM
Comparison plot options	CMPPLOT HISTPLOT HSTSCALE
Comparison plot title	CMPTITLE
Comparison times	CMPEPHEM
Consider mode	CONSIDER
Convergence ratio (DC Program)	CONVERG
Coordinate system orientation, initial condition (first three components)	ELEMENT1
Coordinate system orientation, initial condition (first three components) of an ATSR relay satellite	SSELEM1
Coordinate system orientation initial conditions (first three components) of a TDRS relay satellite	TDRELEM1
Coordinate system orientation, initial condition (second three components)	ELEMENT2
Coordinate system orientation, initial condition (second three components) of relay satellite	SSELEM2 TDRELEM2

Function	Keyword
Coordinate system orientation, integration	ORBTYPE
Coordinate system orientation, maneuvers	IMPULSE
Coordinate system orientation, output from an EPHEM Program run	OUTCOORD
Coordinate system orientation, SLP ephemeris	SLPCOORD
Coordinate type, initial condition	ELEMENT1 ELEMENT2
Coordinate type, initial condition of relay satellite	SSELEM1 SSELEM2 TDRELEM1 TDRELEM2
Coordinate type, output	OUTTYPE
Covariance matrix, mapping of state	STATEPAR
Covariance matrix, ATSR relay satellite state	SSCOVAR
Covariance matrix, TDRS relay satellite state	TDRCOV1 TDRCOV2 TDRCOV3
Covariance matrix, state	COVARNC
Create Observation Working File	WORKOBS
DATASIM Program input specification	DSPEA2
DATASIM Program output options	DSPEA3
DATASIM Program output type	DSPEA1
DATASIM Program times	DSPEA1 DSPEA2
Declination, polynomial or trigonometric coefficients	ATTANG2
Declination, solving for and computing partial derivatives	ATTPAR
Degree, equations of motion	MAXDEGEQ
Degree, equations of motion for a TDRS relay satellite	TDRMODEQ
Degree, variational equations	MAXDEGVE
Degree, variational equations for a TDRS relay satellite	TDRMODVE
Degree of curve-fit for rotation matrices and noncentral bodies	SLPDEG

Function	Keyword
Delete observations	Dbbb****
Delimiters	END FIN
Density table	ATMOSDEN
Distance from current central body for sectioning to occur	DISTCB
Distance from next central body for sectioning to occur	DISTNCB
Drag	DRAG
Drag coefficients	DRAGCOF
Drag parameters and partial derivatives	DRAGPAR
Drag parameter sectioning	DRAGPOLY
EARLYORB Program method selection	TYPE
Earth Potential Fields File report	EPOTRPT
Edit parameters	EDIT
Edit parameters, SOR	SORINPUT
Elements, initial condition	ELEMENT1 ELEMENT2 EPOCH
Elements, initial condition of relay satellite	SSELEM1 SSELEM2 SSEPOCH TDRELEM1 TDRELEM2 TDREPOCH
Elements, GTDS Permanent File report	ELSRPT
Elements, working file	WORKELS
Elements, 24-Hour Hold Elements File report	ELS24RPT
Elevation angle, minimum allowable	TRACKELV
Ellipsoid model	ELLMODEL
End time, DC Program data span	OBSINPUT
End time, EPHEM Program print arc	OUTPUT
End time, EPHEM, ORB1, or ORBIT File	OUTOPT
Ephemeris merge	EPHMERGE
Ephemeris output files (EPHEM, ORB1, ORBIT)	OUTOPT
Epoch specification, initial conditions	EPOCH

Function	Keyword
Epoch specification, initial conditions of an ATSR relay satellite	SSEPOCH
Epoch specification, initial conditions of a TDRS relay satellite	TDREPOCH
Equations of motion, degree	MAXDEGEQ
Equations of motion, degree (relay satellite)	TDRMODEQ
Equations of motion, order	MAXORDEQ
Equations of motion, order (relay satellite)	TDRMODEQ
Equations of motion, order for Cowell integrator	INTEG
Equatorial radius	BODYRAD
ANALYSIS Program input specification	DSPEA2
ANALYSIS Program times	DSPEA1 DSPEA2
FORTRAN unit numbers of two files to be compared	CMPFILES
GMAN table definition	THTAB1 THTAB2
Gravitational constants for specified bodies	GMCON
Impact modeling eable	IMPACT
Impulsive Maneuvers File	MANURPT
Input processor, initiate	CONTROL
Integration, lower truncation error bound of	LOWBOUND TOLER
Integration, nominal truncation error bound of	NOMBOUND TOLER
Integration, shell mode	SHELLRAD
Integration, upper truncation error bound of	TOLER UPPBOUND
Integration central body	CBODY
Integration Coefficients File Report	INTCRPT
Integration Coefficients Working File	WORKINT
Integration coordinate system orientation	ORBTYPE
Integration order (equations of motion and variational equations)	INTEG
Integration starter	RESTART
Integration step mode	ORBTYPE INTMODE SHELLRAD

Function	Keyword
Integration step size	ORBTYPE SHELLRAD STEPSIZE TDRSTEP
Integration tolerances	TOLER
Integration type	INTEG
Intermediate output	INTEROUT
Inverse of flattening coefficients	FLATCOEF
Ionospheric Refraction Working File	WORKIONO
Iteration control	CONVERG TOLER
Jacchia-Roberts density model	ATMOSDEN
Landmark camera/picture biases	PICBIAS
Landmark observations processing	LNDPAR
Level of ORBIT File	OUTOPT TDRFILES
Lifetime study	LIFETIME
Lower truncation error bound	LOWBOUND TOLER
Lunar Potential Fields File Report	LPOTRPT
Maneuvers	IMPULSE MANMASS MANTIME
Maneuvers model, working file	WORKMAN
Mapping of epoch covariance matrix	MAPTIMES
Mapping of state covariance matrix	STATEPAR
Marquardt algorithm	MODDC
Mass, area, and diameter of relay spacecraft	SSOPT TDRSCPRM
Mass, area, and diameter of spacecraft	SCPARAM
Mass, area, and diameter of a TDRS spacecraft	TDRSCPRM
Matrices, degree of curve-fit (SLP ephemeris)	SLPDEG
Matrix, relay satellite state covariance	SSCOVAR TDRCOV1 TDRCOV2 TDRCOV3

Function	Keyword
Matrix, state covariance	COVARNC
Matrix analysis, normal (DC Program)	CONVERG
Maximum number of DC Program iterations	CONVERG
Mean equatorial radius	BODYRAD
Merge of two EPHEM Files or ORB1 Files	EPHMERGE
Minimum allowable elevation angle	TRACKELV
Minimum step size for integration	TOLER
Multistep starter, integration	RESTART
Noise standard deviation, observations	CHWT**** OBSDEV
Noise determination criteria	NOIS****
Nominal truncation error bound	NOMBOUND TOLER
Noncentral body	NCBODY
Noncentral body, degree of curve-fit (SLP)	SLPDEG
Noncentral body (SLP ephemeris)	SLPBODY
Normal matrix analysis or inverse test (DC Program)	CONVERG
NPQs, Brouwer drag coefficients	NPQPAR
Number of flight sections	MAXSECT
Numerical averaging, VOP	AVERAGE
Numerical integration type	INTEG
Numerical partial derivatives	STATEPAR
Observations acceptance criteria	Aɓɓɓ****
Observation accept/reject criteria	ACCREJ
Observation cards	OBSINPUT WORKOBS
Observation correction parameters	OBSCORR
Observation deletion criteria	Dɓɓɓ****
Observation edit parameters	EDIT
Observation (maximum number)	MAXOBS
Observation noise standard deviation	CHWT**** OBSDEV

Function	Keyword
Observation numbers, set for EARLYORB Program	OBSNUME
Observation residual output frequency	PRINTOUT
Observation source (DODS format)	OBSINPUT
Observation source (GTDS format)	OBSINPUT
Observation source overrides for TDRS relay	TDROBSIN
Observation weighting factor constant	CWEIGHT
Observation Working File creation	WORKOBS
Orbit comparison	CMPEPHEM CMPPLOT CMPTITLE
Orbit generator reference date	TIMES
Orbit generator type	ORBTYPE
Orbit generator type, relay satellite orbit	SSOPT TDRORB
Orbital Elements Report	DCFDR
ORBIT File (output) generation for TDRS relay	TDRFILES
ORB1 or ORBIT File (EPHEM Program run)	OUTOPT
ORB1 or ORBIT File comparison	CMPEPHEM CMPPLOT CMPTITLE
Orientation of coordinate system for output	OUTCOORD
Order, equations of motion	MAXORDEQ
Order, equations of motion for a TDRS relay satellite	TDRMODEQ
Order, integration	INTEG
Order, variational equations	MAXORDVE
Order, variational equations for a TDRS relay satellite	TDRMODVE
Osculating-to-mean element procedure, default modifications	MEANEL
Output coordinate system orientation	OUTCOORD
Output coordinate type	OUTTYPE OUTPUT
Output frequency, observation residuals	PRINTOUT
Output interval (EPHEM or ORB1 File)	OUTOPT
Output partial derivatives option	OUTPART

Function	Keyword
Output reference body	OUTBODY
Output reference system	OUTTYPE
Output to printer (EPHEM Program run)	OUTPUT
Paddle configuration, spacecraft parameters	SCPARAM2
Parameters, TDRSS	TDRSCPRM
Partial batch request parameters	RTPARAMS
Partial batch, satellite ID request	RTSATID
Partial batch, tracking station request	RSTA****
Partial batch, tracking system request	RSYS****
Partial derivatives, analytical	STATEPAR
Partial derivatives, declination	ATTPAR
Partial derivatives, drag	DRAGPAR
Partial derivatives, harmonics	CNM SNM
Partial derivatives, numerical	STATEPAR
Partial derivatives, output	OUTPART OUTOPT
Partial derivatives, pitch angle	ATTPAR
Partial derivatives, right ascension	ATTPAR
Partial derivatives, roll angle	ATTPAR
Partial derivatives, solar radiation	SOLRDPAR
Partial derivatives, solar radiation for a TDRS relay satellite	TDRREFLC
Partial derivatives, state vector	STATEPAR STATETAB
Partial derivatives, state vector for a TDRS relay satellite	TDRSTPAR
Partial derivatives, yaw angle	ATTPAR
Partial tracking report, option specification	PARTRTMS
Pass, bias	PASSTIME
Pass, type	PASSTIME
PCE observations	OBSINPUT
Perturbation tape option	ORBTYPE
Pitch angle, polynomial or trigonometric coefficients	ATTANG2
Pitch angle, solving for and computing partial derivatives	ATTPAR

Function	Keyword
Plot, options	HISTPLOT
Plot, orbit comparison	CMPPLOT
Plot, scales	HSTSCALE
Plot title, orbit comparison	CMPTITLE
Polar motion option	POLAR
Polynomial coefficients of vehicle declination or pitch angle	ATTANG2
Polynomial coefficients of vehicle right ascension or yaw angle	ATTANG1
Polynomial coefficients of vehicle roll angle	ATTANG3
Potential field retrieval	POTFIELD
Quality control of EPHEM or ORB1 Files	EPHQLCRT
Radial distance for integration, shell mode	SHELLRAD
Radius, mean equatorial	BODYRAD
Radius of closest approach, central body	RCACB
Radius of closest approach, noncentral body	RCANCB
Range ambiguity override	RAMB****
Range ambiguity algorithm	RAMBOPT
Reference body, initial conditions	ELEMENT1
Reference body, integration	CBODY
Reference body, output	OUTBODY
Reference date	EPOCH TIMES
Reference output system	OUTTYPE
Refraction, Ionospheric Working File	WORKIONO
Reject/accept observations	ACCREJ
Relay satellite identification number	RELAYID
Report Astrodynamic Constants File	CONSTRPT
Report Atmospheric Density Models File	ATMOSRPT
Report GTDS Permanent Elements File	ELSRPT
Report Earth Potential Fields File	EPOTRPT
Report Flight Sectioning Models File	SECTRPT
Report Integration Coefficients File	INTCRPT
Report Lunar Potential Fields File	LPOTRPT

Function	Keyword
Report SLP Ephemeris File by body	SLPELRPT
Report SLP Ephemeris File by matrix order	SLPRPT
Report Tracking Station Geodetics File	GEODRPT
Report 24-Hour Hold Elements File	ELS24RPT
Resonance potential	AUTOFORC
Right ascension, solving for and computing partial derivatives	ATTPAR
Right ascension of prime meridian	RAPRIME
Right ascension of prime meridian time	RATIME
Right ascension of spin axis	ATTANG1
RMS, initial value	EDIT
RMS added factor	EDIT
RMS sigma multiplier	EDIT
Roll angle, polynomial or trigonometric coefficients	ATTANG3
Roll angle, solving for and computing partial derivatives	ATTPAR
Rotation matrixes, degree of curve-fit of	SLPDEG
Rotation rates (bodies)	BDROTATE
Runge-Kutta starter	RESTART
Satellite grouping option	SATGROUP
Satellite mass for impulsive maneuver	MANMASS
Satellite-to-satellite data simulation	SSTSIM
Save Observation Working File (GTDS format)	SAVE
Section on apofocal point	APOFOCAL
Section on distance from current central body	DISTCB
Section on distance from next central body	DISTNCB
Section on sphere of influence	SPHINF
Section on time of flight	TOF
Sections, number of flight	MAXSECT
Shell mode, integration	SHELLRAD
Sigma, initial value (RMS)	EDIT
Sigma adder	EDIT

Function	Keyword
Sigma multiplier	EDIT
SLP ephemeris, bodies	SLPBODY
SLP ephemeris, coordinate system orientation	SLPCOORD
SLP ephemeris, degre of curve-fit	SLPDEG
SLP Ephemeris File Report by body	SLPELRPT
SLP Ephemeris File Report by matrix order	SLPRPT
$S_{n,m}$ harmonic coefficients	HARMONIC SNM
Solar radiation option	SOLRAD
Solar radiation parameters and partial derivatives	SOLRDPAR TDRREFLC
Source, input observations	OBSINPUT
Source of SLP data	SLPFILE
Spacecraft parameters (area, mass, and radius)	SCPARAM
Spacecraft parameters, cylindrical and paddle configuration	SCPARAM2
Sphere of influence	SPHERE
Sphere of influence sectioning	SPHINF
Standard deviation, declination coefficients	DECLVAR
Standard deviation, drag parameters	DRAGPAR
Standard deviation, observation noise	CHWT**** OBSDEV
Standard deviation, pitch angle coefficients	DECLVAR
Standard deviation, right ascension coefficients	RTASCVAR
Standard deviation, roll angle coefficients	ROLLVAR
Standard deviation solar radiation	SOLRDPAR TDRREFLC
Standard deviation, yaw angle coefficients	RTASCVAR
Start time, DC Program data span	EPOCH OBSINPUT
Start time, EPHEM Program Run (EPHEM, ORB1, or ORBIT File)	OUTOPT
Start time, EPHEM Program run print arc	EPOCH TIMES

Function	Keyword
Starter, integrator option	RESTART
State covariance matrix	COVARNC
State covariance matrix, ATSR relay satellite	SSCOVAR
State covariance matrix, TDRS relay satellite	TDRCOV1 TDRCOV2 TDRCOV3
State parameters (unknowns)	STATETAB
State partial derivatives, output	OUTPART
State solve-for parameter component type	STATEPAR
State solve-for parameter component type for a TDRS relay satellite	TDRSTPAR
State vector partial derivatives	STATEPAR
State vector partial derivatives for a TDRS relay satellite	TDRSTPAR
Station list, accept/reject switch	ACCREJ
Station geodetics report	GEODRPT
Station Geodetics Working File	WORKGEO
Station-related data	/*******n
Statistical Output Report (SOR), batching criteria	SELOUT
Statistical Output Report (SOR), batching criteria override	TDRBATCH
Statistical Output Report (SOR) category, mixing a pair of SOR categories	MIXPAIR
Statistical Output Report (SOR), edit parameters	SORINPUT
Statistical Output Report (SOR) generation	SELOUT
Statistical Output Report (SOR) data validity	SORVALID
Stepmode, integration	ORBTYPE INTMODE
Stepsize, integration	ORBTYPE SHELLRAD STEPSIZE TDRSTEP
Stepsize constant, time regularization	TIMREGDV
Stepsize control, lower truncation error bound	LOWBOUND

Function	Keyword
Store elements in 24-Hour Hold Elements File	WORKELS TDRWKELS
Thrust, polynomial coefficients	THRSTPAR THRSTCOF
Thrust, polynomial coefficients for vehicle declination or pitch angle	ATTANG2
Thrust, polynomial coefficients for vehicle right ascension or yaw angle	ATTANG1
Thrust solve-for flags	THSOFNO
Thrust option	THRUST
Time, and ORB1 or ORBIT File	OUTOPT
Time, end print arc (EPHEM Program)	OUTPUT
Time, maneuvers	MANTIME
Time, reference	EPOCH
Time, start (DC Program)	EPOCH OBSINPUT TIMREGDV
Time, start (EPHEM Program)	EPOCH TIMES
Time conversion coefficients files, retrieval of data from	WORKTCOR
Time correction, working file	WORKTCOR
Time differences between observations, minimum	EOINTRVL
Time of flight for sectioning	TOF
Time of right ascension of the prime meridian	RATIME
Time regularization exponent	TIMREG
Time regularization stepsize constant	ORBTYPE
Title cards	TITLE
Title cards, orbit comparison	CMPTITLE
Tolerances, integration	TOLER
Tracking schedule data	DSPEA1
Tracking Station Geodetics File Report	GEODRPT
Transponder delay	TRNDLY
Transponder delay (satellite)	TDRXPNDR
Truncation error bound, lower	LOWBOUND

Function	Keyword
Truncation error bound, nominal	NOMBOUND TOLER
Truncation error bound, upper	TOLER UPPBOUND
Two-body option	TWOBODY
Unknowns (DC Program run, state partials)	STATEPAR STATETAB
Upper truncation error bound	TOLER UPPBOUND
Variable-step ephem files, time, and height intervals between data points of	VAREPHEM
Variance of thrust acceleration	THRSTVAR
Variation of equations, degree	MAXDEGVE
Variational equations, order	MAXORDVE
Variational equations for Cowell integrator	INTEG
VOP, numerical averaging	AVERAGE
VOP parameter type	ORBTYPE
Weighting factor constants	CWEIGHT
Working File, Astrodynamic Constants	WORKCON
Working File, Atmospheric Density	WORKATM
Working File, Elements	WORKELS
Working File, Flight Sectioning Model	WORKSECT
Working File, Integration Coefficients	WORKINT
Working File, Ionospheric Refracton	WORKIONO
Working File, Maneuvers	WORKMAN
Working File, Observations	WORKOBS
Working File, SLP	SLPFILE
Working File, Station Geodetics	WORKGEO
Working File, Time Corrections	WORKTCOR
Yaw angle, polynomial or trigonometric coefficients	ATTANG1
Yaw angle, solving for and computing partial derivatives	ATTPAR

APPENDIX G - SAMPLE PROGRAM INPUT DECKS

```
CONTROL    EPOCH                                                         ALCBM001    781101
ELEMENT1   1   1   1   2571.77233555         6028.21?0?133               349.1155020[illegible]
ELEMENT2               -2.0716466174[illegible]       2.016684043859              -7.3555[illegible]53[illegible]71
EPOCH                  781220.               120000.
OUTPUT     1   2   1   781229.               000000.                     14400.
ORBTYPE    1   1   1   80.
FIN
```

Figure G-1. Sample Ephemeris Generation Run Using Mandatory Cards Only

```
//GO.FT21F001 DD DSN=&FAUL,DISP=(NEW,PASS),UNIT=DISK,
//     SPACE=(CYL,(40,1),RLSE)
//GO.FT24F001 DD DSN=&FAUL,DISP=(NEW,PASS),UNIT=DISK,
//     SPACE=(TRK,(40,5))
//GO.DATA5 DD *
CONTROL    EPHEM                                                AF-C       7310101
ELEMENT1   1   1   1   1467.63              -3854.362           7116.2417
ELEMENT2               3.2641P              6.27091             .617046
EPOCH                  751222.              120000.
OUTPUT     1   3   1   761225.              00.                 43200.
ORBTYPE    1   1   1   100.
OGOPT
POTFIELD   1   5
TITLE      1
OGJ-EPH-TIME REG COWELL,DRAG,SCLRE,LIDES-PRIESTER,EPHEM FILE OUTPUT
DRAG       1           1.0
SCLRAD     1           1.0
SCPARAM                .60000415            4022.
OUTOPT     4   1       761213120000.        761222112000.
TIMES                                       761219.             00.
STATEPAR   1
STATETAB   1   2   3   4.                   5.                  6.
END
FIN
//
```

Figure G-2. Sample Case That Generates an EPHEM Tape and a Sequential ORBIT File With Partial Derivatives

```
//GO.FT18F001 DD SPACE=(2264,24),DISP=(NEW,PASS),DSN=CLB.SLP
//GO.FT34F001 DD UNIT=2400-9,DISP=(OLD,PASS),LABEL=(1,BLP),DSN=JPLT,
//             VOL=SER=31920,DCB=(RECFM=VBS,LRECL=6304,BLKSIZE=8308)
//GO.DATA5 DD *
CONTROL   EPHEM                                                    MARINER     6901001
ELEMENT1  2  2  1   -34140.4570596        1.1851447.            45.5894
ELEMENT2            329.5425147           130.715038            1.844124
EPOCH               690217.               031151.54
ORBTYPE   2  2  1   50.
OUTPUT       2  11  690901.               00.                   172800.
DMOPT
SLPFILE   5  20 11  690216.
SLPBODY   1  3  4
END
UGOPT
DISTCB    1         200000.
CBODY     1  2  3   1.                    3.                    4.
CBODY     4  5  6   4.                    4.                    4.
CBODY     7         4.
MAXSECT   7
NCBODY    1  3  4
NCBODY    2  1  4
NCBODY    3  1  4
NCBODY    4  1  3
NCBODY    5  1  3
NCBODY    6  1  3
NCBODY    7  1  3
STEPSIZE  2  3  4   5000.                 100000.               10000.
STEPSIZE  5  6      5000.                 100.
INTMODE   2  3  4   1.                    1.                    1.
INTMODE   5  6      1.                    2.
DISTCB    2         1480000000.
DISTNCB   3  4  5   2000000.              1000000.              600000.
DISTNCB   6         300000.
RCACE     7
MAXDEGEQ  2  3      0.                    0.
MAXORDEQ  2  3      0.                    0.
SOLRAD    1  2  3   1.                    1.                    1.
SCPARAM             .00000123             172.5
END
FIN
```

Figure G-3. Sample Ephemeris Generation Run That Generates an SLP File, Then Goes Through a Seven-Section Flight, Starting Earth-Centered and Terminating When the Radius of Closest Approach to Mars Is Found

```
//GO.FT18F001 DD SPACE=(2264,24),DISP=(NEW,PASS),DSN=CLU.SLF
//GC.FT34F001 DD UNIT=(2400-4,,DEFER),DISP=CLD,LABEL=(1,BLP),
//            DCB=(RECFM=VBS,LRECL=8304,BLKSIZE=83C0),VCL=SER=32732,
//                    DSN=LIN
//GC.DATA5 DD *
CONTROL EPHEM                                                    IMP-F       6705101
ELEMENT1   2  1  1   -210748.151750000    46965.38130000000    -3735.13934000000
ELEMENT2             -.132643670000000    -.102471370000000    .303713830000000
EPOCH                670524.              C.
ORBTYPE    2  2  2
OUTPUT        3  5   670531.              0.                   21600.
DMOFT
SLPBODY    1  2  3
SLPCOORD   2
SLPDEG     9 12  9
SLPFILE    5 20  4   670521.
END
OGOFT
TITLE      1
TEST CASE ORBIT GENERATION 3
MAXSECT    3
RCACP      1
APOFCCAL   2
SCPAFAM              .00000123            172.5
SOLRAD     1  2  3   1.                   1.                   1.
SOLRDPAR   2         2.
CNM        1  2  0
NCBODY     1  2  3
NCBODY     2  2  3

NCBODY     3  2  3
MAXDEGEO   2  3      3.                   3.
MAXORDEO   2  3      3.                   3.
STATEPAR   1
STATETAB   1  2  3   4.                   5.                   6.
OUTPAFT    1  2  3   1.                   2.                   3.
END
FIN
```

Figure G-4. Sample Ephemeris Generation Run That Creates an SLP File From a JPL Ephemeris Tape and Executes Three Sections, Computing Partial Derivatives and Printing Them Out in Various Reference Frames Each Section

```
CONTROL    EPHEM                                                IMP-H       7207301
ELEMENT1   2  2  1  125402.031        .947158                   26.8306
ELEMENT2            201.6432          141.2598                  .0437377
EPOCH               720923.           013624.
OUTPUT              721023.           00.                       43200.
ORBTYPE    2  2  1
OGOFF
MAXSECT    3
MAXDECEQ   1  2     15.               4.
MAXOFCEQ   1  2     15.               4.
INTMODE    2  3     1.                1.
RESTART    2  3     2.                2.
STATETAB   1  2  3  4.                5.                        6.
STATEPAR   1
IMPULSE    1  1     .1                .05                       .05
MANTIME    1        720924.           00.
MANMASS    1        150.              149.
TOF        1  2     223175.           223197.
ATTANG1    1        -102.19
ATTANG2    1        -5.16
STEPSIZE   2  3     .07               4000.
THRSTCOF   2  1     -.022112115       .04985353                 -.015660969
THRSTCOF   2  4     .0025223634       -.0002260417              .00001151
THRSTCOF   2  7     -.000000307       .00000000305
THRUST     2        1.
THRSTPAR   2        3.
ATTPAR     2        1.
END
FIN
```

Figure G-5. Sample Ephemeris Generation Run That Performs an Impulsive Maneuver as Well as a Finite Burn (Partial Derivatives Also Computed, Including State, Attitude, and Thrust)

```
CONTROL     DC
ELEMENT1    1   1   1   -[illegible].49          -6085.09         AE-C          7310101
ELEMENT2                4.[illegible]4             4.4730           6260.13
[illegible]             7[illegible].              170CCC.            2.C985
[illegible]TYPE 1   1   1   [illegible]
[illegible]INPUT [illegible]     7[illegible]C05[illegible]0.   731227C20000.
[illegible]
```

Figure G-6. Sample DC Using Mandatory Cards Only

```
CONTROL     CC                                                              142-H       7207301
ELEMENT1    2    2    1     125425.311            .9471                    28.655
ELEMENT2                    201.6471              141.2926                 .04571
EPOCH                       720923.               13624.6                  720924000000.
ORBTYPE     2    2    1     50.
OBSINPUT    3               720923000000.         720924153729.
DMODPT
ACCREJ      1
0     BURM
WORKIONO    1    1          720920.               720925.
END
OGOPT
POTFIELD    1    5
STATEPAR    2
STATETAB    1    2    3     4.                    5.                       6.
END
DCOPT
EDIT                                              100.
OBSCORR     5    1          11122.
END
FIN
```

Figure G-7. Sample Case That Executes the Following:
1. Rejects All Data From Station BURM
2. Solves for State in Keplerian Frame
3. Performs Light Time and Refraction Corrections (BENT MODEL), Updating the Corrections Every Fifth Iteration

```
//GO.DATAS LO *
CONTROL    DC
ELEMENT1   2   1   1   593.99 99              -6657.00002             1726.00002         7110901
ELEMENT2                    1.11561              -1.744062                 -7.310299
EPOCH                  711211.0               205700.0
ORBTYPE    2   1   2   60.0
OESIMPUT   3        711211205700.0              711213129000.0
DROPT
/TAN4      1        2  1347.49               -190031.66              471759.750
END
DGOPT
CNM        2   2   3                  1.0-9                                 1.0
CNM        3   2   2                  1.0-9                                 1.0
SNM        2   1   1                  2.0-9                                 1.0
DRAG       1                      1.0
DRAGPAR    1
DRAGCOF    1   1       -.99995
SOLRAD     1           1.0
SOLRDPAR   2               0.0001
SCPARAM                0.00000125             172.5
END
DCOPT
EDIT                   3.0                    100.0                   0.0
CONVERG    5                                                 .1D-5                         .5D-7
/ANK4    4     1
/AGO4    4     1
/GUI4    5     2   1
/FIM4    5     31  1
/ORR4    5     5   1
/TAN4    5     2   1
/ULAMAGPS      5   1
/BUR4    5     3   1
END
FIN
```

Figure G-8. Sample Deck That Performs a Differential Correction Solving for 23 Parameters, Including State, RHO-1, Solar Radiation, 3 Harmonic Coefficients, 2 Station Locations, and 6 Biases

```
//GO.FT80F001 DD DSN=FETALGET,
//     UNIT=DISK,DCB=(RECFM=FB,LRECL=6660,BLKSIZE=6660,BUFNO=1),
//     SPACE=(CYL,(20,2)),DISP=(NEW,DELETE)
//GO.FT91F001 DD DSN=DGOLOUT
//GO.FT95F001 DD UNIT=2314,SPACE=(CYL,(20,2)),
// DCB=(LRECL=160,BLKSIZE=3520,RECFM=FB,BUFNO=1)
//GO.FT97F001 DD DSN=RSPLLAY1,
//     UNIT=DISK,DCB=(RECFM=FB,LRECL=6660,BLKSIZE=6660,BUFNO=1),
//    SPACE=(CYL,(9,1)),DISP=(,DELETE)
//GO.FT98F001 DD DSN=RSPLLAY2,
//     UNIT=DISK,DCB=(RECFM=FB,LRECL=6660,BLKSIZE=6660,BUFNO=1),
//    SPACE=(CYL,(9,1)),DISP=(,DELETE)
//GO.FT99F001 DD DSN=RSPLLAY3,
//     UNIT=DISK,DCB=(RECFM=FB,LRECL=6660,BLKSIZE=6660,BUFNO=1),
//    SPACE=(CYL,(9,1)),DISP=(,DELETE)
//GO.DATA5 DD *
CONTROL    DC                                                         GEOS-3   19 7502701
EPOCH                        790301.
ELEMENT1     1   1   1       4075.056610371
                                                 -4253.2075037371     -3045.4468826469
ELEMENT2                     -4.3049563039833    -.81978927719346     -5.9562942957089
ORBTYPE      2   1   2       1.
OBSINPUT22                   790227000000.       790303000000.
TDROPT
TDRTO        1   3           790101.             790301.
TDRSTEP                      600.                4.                   4.
TDREPOCH     1               790220.                                  790301000000.
TDRSTPAR     1       1       1.
TDRELEM1     1   2   2       42160.              .0005                .75
TDRELEM2     1               96.                 240.                 16.21
TDRORB       1   2           .00004              2132.
TDRREFLC     1   1   1       1.
TDREPOCH     3               790220.                                  790301000000.
TDRSTPAR     3       1       1.
TDRELEM1     3   2   2       42166.              .00001               .05
TDRELEM2     3               196.                0.                   224.22
TDRORB       3   2           .00004              2132.
TDRREFLC     3   1   1       1.5
TDREPOCH     7               790220.                                  790301000000.
TDRELEM1     7   2   2       42160.              .0001                1.25
TDRELEM2     7               290.                120.                 71.21
TDRORB       7   2           .00004              2132.
TDRREFLC     7   1   1       1.5
TDRSTPAR     7       3       1.
TDRXPODR     1   1           .000001031
TDRXPODR     3   1           .000000092
END
DXCPT
```

Figure G-9. Sample Deck That Performs a Differential Correction With TDRSS Satellites and Generates Statistical Output Reports (1 of 2)

```
SELOUT     [illegible]
/WHSK    1   1[illegible] 15   1991.[illegible]          3[illegible].[illegible]57           2532329.16[illegible]
/WH2K    1   1[illegible] 1[illegible]   1991.[illegible]          32[illegible]2.[illegible]7          2532329.16[illegible]
/WHSK    1   1[illegible] 15   1991.[illegible]          32[illegible]1.[illegible]          2532329.163
/WHSJ    1   [illegible] 15   1991.[illegible]7          [illegible]3.357          2532329.162
/MAPJ    [illegible]   [illegible] 15   [illegible]          4[illegible]71[illegible].[illegible]          2554952.546
/UPPJ    1   [illegible] 15   [illegible]          -3[illegible]791.712          1465725.352
END
DCOPT
CONVERG    5
/WH2K    4     1
/WH3K    4     1
/WH2K    5   [illegible]   1
/WH2K    5   [illegible]   1   1[illegible].5
/WH2K    5   [illegible]   1
/WH2K    5   [illegible]   1
/WH3K    5   [illegible]   1
/WH3K    5   [illegible]   1
/WH3K    5   [illegible]   1
/WH2K    5   [illegible]   1
ACCREJ   1[illegible]
D   ALLF             [illegible]500.
D   ALLF             [illegible]00.
D   ALLF             9[illegible]100.
D   ALLF             9[illegible]00.
D   ALLS
D   ALLA
D   ALLS             1[illegible]01900.
D   ALLR             1[illegible].
D   ALLF             [illegible].          7[illegible]1022900.          790301023000.5
D   ALLF             [illegible].          7[illegible]1025029.          790301023030.5
D   ALLF             [illegible].          7[illegible]301160029.          790301160931.
D   ALLR             [illegible].          7[illegible]301160129.          790301160130.5
TRACKLEV  5   5 11   -[illegible].          -[illegible].          -89.
EDIT                                        120.
ATMOSDEN  [illegible]
END
DCOPT
SCPARAM              .[illegible]           [illegible].56
DRAG      1          1.
DRAGPAR   1
MAXORDER  1          [illegible].
MAXDEGER  1          [illegible].
MAXORDVE  1          4.
MAXDEGVE  1          4.
END
```

Figure G-9. Sample Deck That Performs a Differential Correction With TDRSS Satellites and Generates Statistical Output Reports (2 of 2)

```
//GO.FT[illegible] [illegible] DSN=[illegible],UNIT=DISK,DISP=(,PASS),
//   SPACE=(TRK,([illegible])),
//              DCB=([illegible]=VS,LRECL=136,BLKSIZE=1636,BUFNO=1)
//GO.DATA5 DD *
CONTROL   [illegible]                                      ERIS      1234567
ELEMENT1  1  1  1  7[illegible]        -3749.147          6247.289
ELEMENT2            -[illegible]       5.[illegible]      3.626661
ORBTYPE   2  1  1  15[illegible].
EPOCH               73[illegible].     200000.
OUTPUT    1  1  1   73[illegible].     00.                43200.
OC[illegible]
OUTOFF    1         73[illegible].     7306130900000.
END
FIN
CONTROL   [illegible]                                      ERIS      1234567
ELEMENT1  1  1  1   7[illegible]       -3749.147          6247.289
ELEMENT2            -[illegible]       5.[illegible]72    3.626661
ORBTYPE   2  1  1   20[illegible].
OUTPUT    1  1  1   7[illegible]14.    00.                43200.
EPOCH               73[illegible]12.   200000.
OSOPT
OUTOFF    1         73[illegible].     7306130900000.
END
FIN
CONTROL   COMPARE                                          ERIS      1234567
COMPOPT
CMPEPHEM  1104100   73[illegible]100.  7306130859000.
CMPPLOT   2
END
FIN
CONTROL   COMPARE                           X              ERIS      1234567
COMPOPT
CMPEPHEM  [illegible]  7[illegible].   7306130[illegible].
CMPPLOT   [illegible]
END
FIN
```

Figure G-10. Sample Stacked Cases Where Two ORB1 Tapes Are Generated, Then the COMPARE Program Is Executed

```
//GO.FT15F001 DD *
OBSCARD
ACN3      1      791024212340.      3188.174      3188.174
ACN3     17      791024212340.      1.4922565     1.4922565
ACN3     18      791024212340.      -.6283185     -.6283185
ACN3      1      791024212440.      2931.768      2931.768
ACN3     17      791024212440.      1.445132      1.445132
ACN3     18      791024212440.      -.514872      -.514872
ACN3      1      791024212540.0     2710.096      2710.096
ACN3     17      791024212540.0     1.40499       1.40499
ACN3     18      791024212540.      -.380402      -.380402
ACN3      1      791024212640.      2533.407      2533.407
ACN3     17      791024212640.      1.373574      1.373574
ACN3     18      791024212640.      -.225147      -.225147
ACN3      1      791024212740.      2412.574      2412.574
ACN3     17      791024212740.      1.349139      1.349139
ACN3     18      791024212740.      -.052359      -.052359
END
ACN3      1      791024212340.      3188.174      3188.174
ACN3     17      791024212340.      1.4922565     1.4922565
ACN3     18      791024212340.      -.6283185     -.6283185
ACN3      1      791024212440.      2931.768      2931.768
ACN3     17      791024212440.      1.445132      1.445132
ACN3     18      791024212440.      -.514872      -.514872
ACN3      1      791024212540.0     2710.096      2710.096
ACN3     17      791024212540.0     1.40499       1.40499
ACN3     18      791024212540.      -.380402      -.380402
ACN3      1      791024212640.      2533.407      2533.407
ACN3     17      791024212640.      1.373574      1.373574
ACN3     18      791024212640.      -.225147      -.225147
ACN3      1      791024212740.      2412.574      2412.574
ACN3     17      791024212740.      1.349139      1.349139
ACN3     18      791024212740.      -.052359      -.052359
END

//GO.DATA5 DD *
CONTROL   EARLYORB                                        ERTS      7205801
EPOCH            791024.            235910.
OBSINPUT  5      791024150000.
TYPE      7 -1  1    7285.          7285.                 2.
OGOPT
TITLE     1
E04--EARLY ORB 2--AUTOMATIC DOUBLE-R METHOD
END
```

Figure G-11. Sample Stacked Cases of Early Orbit Programs With Observations Input via OBSCARDS (1 of 3)

```
FIN
CONTROL    EARLYORB                                          ERIS       7205801
EPOCH               791024.             235010.
OBSINPUT 11           791024150000.
TYPE        5 -1  1    7285.            7285.                2.
OGOPT
TITLE       1
E04--EARLY ORB 3--AUTOMATIC RANGE AND ANGLES METHOD
END
FIN
CONTROL    EARLYORB                                          ERIS       7205801
EPOCH               791024.             235010.
OBSINPUT  5           791024150000.
OBSNUME  17 16        791024212340.     791024212440.     791024212540.
OBSNUME  17 16        791024212640.     791024212740.
TYPE        2 -1  1    7285.            7285.                2.
OGOPT
TITLE       1
E04--EARLY ORB 4--DOUBLE-R ITERATION METHOD
END
FIN
CONTROL    EARLYORB                                          ERIS       7205801
EPOCH               791024.             235010.
OBSINPUT 11           791024150000.
TYPE        5 -1  1    7285.            7285.                2.
OGOPT
TITLE       1
E04--EARLY ORB 5--AUTOMATIC RANGE AND ANGLES-WITH NO RANGE DATA (GAUSS)
END
FIN
CONTROL    EARLYORB                                          GEOS-3     7502701
EPOCH
OBSINPUT  6           810761000000.     811201000000.
TYPE        6     1    7500.
OGOPT
TITLE       1
E04--EARLY ORB 6--AUTOMATIC GAUSS METHOD; OBSINPUT 6
END
FIN
CONTROL    EARLYORB                                          GEOS-3     7502701
EPOCH
OBSINPUT  3           810761000000.     811201000000.
TYPE        5     1    7500.
OGOPT
TITLE       1
E04--EARLY ORB 7--AUTOMATIC RANGE AND ANGLES; OBSINPUT 3
END
```

Figure G-11. Sample Stacked Cases of Early Orbit Programs With Observations Input via OBSCARDS (2 of 3)

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```
FIN
CONTROL     EARLYORB                                          GEOS-3     7502701
EPOCH
OBSINPUT    8          810701000000.       811201000000.
EOINTRVL               180.
TYPE        6      1   7300.
OGOPT
TITLE       1
E04--EARLY ORB 6--AUTOMATIC GAUSS METHOD; OBSINPUT 8
END
FIN
CONTROL     EARLYORB                                          GEOS-3     7502701
EPOCH
OBSINPUT    8          810701000000.       811201000000.
EOINTRVL               180.
TYPE        5      1   7300.
OGOPT
TITLE       1
E04--EARLY ORB 7--AUTOMATIC RANGE AND ANGLES; OBSINPUT 8
END
FIN
```

Figure G-11. Sample Stacked Cases of Early Orbit Programs With Observations Input via OBSCARDS (3 of 3)

```
CONTROL    EPHEM                                                        UK-4        7110901
ELEMENT1   3  1  1   594.                    -6657.                     1726.8
ELEMENT2              1.1168                    -1.74406                   -7.3183
EPOCH                720102.0
ORBTYPE    2  1  2   60.0
OUTPLT     2  2  1    720103.0                       0.0                            3600.0
OGOPT
POTFIELD   1  5
SCPARAM              0.00000123              172.5
OUTOPT     0  2  0   720102000000.0             720102140000.0
END
FIN
CONTROL    CATASIM                                                      UK-4        7110901
DMOPT
/TOWATS 1   111  3   587.                     -272345.8                 1515619.53
/MOJATSS1   222  4   858.16                   351954.0                  2430644.76
/TOWATS 2     1  0    0.0                     0.0                       2200 .0
/MOJATSS2     1  0    0.0                     0.0                       2200 .0
END
DCOPT
DSPEA1     1  2  1   720102.0                   5030.0                     60.0
DSPEA2               720102.0                    130000.0
END
FIN
```

Figure G-12. Sample Case Generating Simulated Data After First Generating a Sequential ORBIT File

```
CONTROL   EPHEM                                                   NIMBUS-6    7505201
ELEMENT1  2  1  1  -1364.417872196371   2334.063476491259         -6955.086495166348
ELEMENT2           -.2613891377160646   6.670412695524795         2.401661770791966
EPOCH              760702.              000000.
ORBTYPE   2  1  2  60.0
OUTPUT    2  2  1  760702.              021000.                   300.
CGOPT
OUTOPT    0  1  1  760702000000.        760702021000.             60.
OUTPART   1  0  0  1.
STATEPAR  1
END
FIN
CONTROL   ANALYSIS                                      RESTORE   NIMBUS-6    7505201
AMEPT
/HLV    1       1  500.0                -300000.0                 1800000.0
/HLM    1       2  900.0                -300000.0                 1800000.0
/PHLT   1       3  500.0                450000.0                  1540000.0
/PHLM   1       2  500.0                450000.0                  1540000.0
/AHLV   1       1  500.0                640000.0                  130000.0
/AHLT   1       3  500.0                640000.0                  130000.0
/APLM   1       2  500.0                640000.0                  130000.0
/PARV   1       1  500.0                0.0                       3360000.0
/PARM   1       2  500.0                0.0                       3360000.0
/IEDT   1       3  500.0                -650000.0                 2950000.0
/IEDM   1       2  500.0                -650000.0                 2950000.0
/CHRV   1       1  500.0                -450000.0                 1600000.0
/CHRM   1       2  500.0                -450000.0                 1600000.0
END
DCOPT
DSPEA1    2  0     760702.              030130.                   15.
DSPEA2   19  1  0  760702.              020500.
DSPEA3    0  1  0
MAPTIMES  1  1  1  760702010000.        760702025000.             600.
END
FIN
```

Figure G-13. Sample Stacked Cases Where an EPHEM Program and Error Analysis Program are Executed, Then the Permanent File Report Generation Program and the Data Simulation Program are Executed (1 of 2)

```
CONTROL   FILERPT
PFFOPT
PPCTRPT
LPOTRPT
END
FIN
CONTROL   DATASIM                                     RESTORE   NIMBUS-6   7505201
SHORT
/HWLV    1      1   500.0          -300000.0              1800000.0
/HWLM    1      2   500.0          -300000.0              1800000.0
/PPLT    1      3   500.0           450000.0              1540000.0
/PALM    1      2   500.0           450000.0              1540000.0
/ALLV    1      1   500.0           640000.0              130000.0
/AULT    1      3   500.0           640000.0              130000.0
/AUL4    1      2   900.0           640000.0              130000.0
/BARV    1      1   900.0           0.0                   3360000.0
/BARM    1      2   500.0           0.0                   3360000.0
/HDPT    1      3   500.0          -650000.0              2950000.0
/HPOM    1      2   500.0          -650000.0              2950000.0
/CHRV    1      1   500.0          -450000.0              1600000.0
/CHRM    1      2   500.0          -450000.0              1600000.0
END
SCOPT
DSPEA1      2   0     760702.        000110.              15.
DSPEA2     19   1   0 760702.        020500.
END
FIN
```

Figure G-13. Sample Stacked Cases Where an EPHEM Program and Error Analysis Program are Executed, Then the Permanent File Report Generation Program and the Data Simulation Program are Executed (2 of 2)

```
COLUMN 1
       CONTROL   FILERPT                                                        7801301
       PFLOPT
       ATMOSRPT  1  1 11
       ATMOSRPT  2  1
       CONSTRPT  2
       ELSRPT    1  2  P
       ELS2RPT   1  1                        600101000000.0        850101000000.0
       EPOTRPT   2
       GENDRPT
       INTCRPT   1
       LPLTRPT   2
       MANURPT   1
       SECTRPT   1  1
       SLPRPT    3        780101.0           780630.0
       END
       FIN
```

Figure G-14. Sample Deck Requesting Permanent File Reports

APPENDIX H - OUTPUT

Three general categories of GTDS output provide extensive information to the user:

- Printer Output
- Scope Output
- Special Output

The available scope output is discussed in detail in the GTDS Graphics User's Guide (Reference 3). Special output includes data sets such as ORB1, EPHEM, and ORBIT Files.

The following discussion covers the GTDS output for the printer. This output is actually spooled by the MVS operating system to a disk file, and routed from disk to a printer if so directed by the user's JCL. Although the spooled reports may be inspected by a TSO user during and after GTDS execution, they are commonly referred to as printer reports.

The areas in which the system is capable of generating printer reports include

- Input Processor and Run Control
- Ephemeris Generation (EPHEM) Program
- Differential Correction (DC) Program
- Filter (FILTER) Program (currently not available)
- Early Orbit Determination (EARLYORB) Program
- Data Simulation (DATASIM) Program
- Error Analysis (ANALYSIS) Program
- Ephemeris Comparison (COMPARE) Program
- Data Management (DATAMGT) Program
- Permanent File Report Generation (FILERPT) Program

Samples of many of the reports are given in the figures in this appendix.

H.1 INPUT PROCESSOR

The input processor generates four printer reports. The first, second, and third reports are generated with every GTDS program run. The fourth is generated unless the user specifies that it is to be suppressed (see Section 2.1). The four reports are:

- GTDS report index
- GTDS title page and accounting information
- Input card deck images listing
- Input processor interpretation of each card

The user has no options pertaining to the report index, the title page, and the card deck images. These are shown together in Figure H-1. The GTDS report index is a listing of the major reports produced by the GTDS job and the page number of the current run on which each begins. This report is intended to help the user inspecting printer reports during a TSO session to locate that part of the run in which he or she is interested.

The GTDS title page reflects information such as program location in cord and run time. The accounting information appears for each GTDS program execution (i.e., once for each CONTROL keyword card). This report also lists all data sets allocated to GTDS for the duration of the job step. The data set allocationsappear only at the beginning of the GTDS run (i.e., for the first CONTROL keyword card).

The card image output is merely a column-for-column, card-for-card printout of the input cards.

*** * * * GTDS REPORT INDEX * * * ***

TEMPLATE: PAGE123456

Figure H-1. GTDS Report Index, Title Page, and Input Card Deck Image (1 of 4)

GODDARD TRAJECTORY DETERMINATION SYSTEM

GTDS

NASA/GSFC

GTDS VERSION [illegible]

JOB IDENTIFICATION: [illegible] COMPILER IDENTIFICATION: [illegible] STARTING ADDRESS OF MAIN: [illegible]

GTDS RUN NUMBER [illegible] RUN DATE: [illegible] TIME: [illegible] HRS [illegible] MINS [illegible] SECS

DATA SET ALLOCATIONS

DDNAME	NAME	CREATE DATE	VOLSER	LABEL	DEVC	CATEGORY
STEPLIB	[illegible].GTDSDEV.LOAD	[illegible]	[illegible]		D.A.S.D.	2314
	[illegible].GTDS.LOADMOD.LOAD	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.DIRECTRY.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.MANEUVER.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.ASTROCON.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.LUNARFLD.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.INTCOEF.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.SECTIONS.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	[illegible].GTDS.ERRORMSG.DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	[illegible].GTDS.[illegible].DATA	[illegible]	[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	SYS[illegible]		[illegible]		D.A.S.D.	2314
[illegible]	NULLFILE					
[illegible]	NULLFILE					
[illegible]	NULLFILE					

Figure H-1. GTDS Report Index, Title Page, and Input Card Deck Image (2 of 4)

F151F001	NULLFILE				
F152F001	NULLFILE				
F153F001	NULLFILE				
F154F001	NULLFILE				
F155F001	NULLFILE				
F157F001	SYS81119.T091951.RV000.ZB3DBSIM.R0001300		SCR102	D.A.S.D.	2314
F158F001	SYS81119.T091951.RV000.ZB3DBSIM.SIONO		SCR104	D.A.S.C.	2314
F159F001	ORBIT.GTDS.SOLCAT.DATA	74/ 59	DISK19	C.A.S.C.	2314
F160F001	ORBIT.GTDS.ACCOUNT.DATA	74/ 55	DISK19	D.A.S.D.	2314
F162F001	NULLFILE				
F164F001	NULLFILE				
F165F001	SYS81119.T091951.RV000.ZB3DESIM.IONDAT		SCR100	D.A.S.D.	2314
F167F001	NULLFILE				
F168F001	ORBIT.GTDS.TRODAT.DATA	75/ 78	DISK19	D.A.S.C.	2314
F169F001	NULLFILE				
F170F001	NULLFILE				
F171F001	NULLFILE				
F172F001	NULLFILE				
F173F001	NULLFILE				
F175F001	ORBIT.GTDS.JACCHIA.DATA	74/ 55	DISK19	D.A.S.D.	2314
F177F001	SYS81119.T091951.RV000.ZB3DBSIM.R0001305		SCR103	D.A.S.D.	2314
F178F001	ORBIT.GTCS.SLPTOD.DATA	80/203	DISKD0	D.A.S.D.	2314
F180F001	SYS81119.T091951.RV000.ZB3DESIM.TARGET		SCR102	D.A.S.C.	2314
F181F001	SYS81119.T091951.RV000.ZB3DBSIM.R0001310		SCR104	D.A.S.C.	2314
F182F001	NULLFILE				
F183F001	SYS81119.T091951.RV000.ZB3DBSIM.R0001311		SCR100	D.A.S.D.	2314
F184F001	NULLFILE				
F185F001	SYS81119.T091951.RV000.ZB3DESIM.R0001312		SCR103	D.A.S.D.	2314
F186F001	NULLFILE				
F187F001	SYS81119.T091951.RV000.ZB3DBSIM.R0001313		SCR102	D.A.S.D.	2314
F188F001	NULLFILE				
F191F001	NULLFILE				
F192F001	SYS81119.T091951.RV000.ZB3DBSIM.EAP		SCR104	D.A.S.D.	2314
F193F001	SYS81119.T091951.RV000.ZB3DBSIM.EAPI		SCR100	D.A.S.D.	2314
F194F001	NULLFILE				
F195F001	SYS81119.T091951.RV000.ZB3DESIM.R0001314		SCR103	D.A.S.C.	2314
F196F001	ORBIT.DMN60.DATA	81/ 53	DISK01	D.A.S.D.	2314
F197F001	NULLFILE				
F198F001	NULLFILE				
F199F001	NULLFILE				
INPUTPUS	NULLFILE				
NUCLEUS	SYS81119.T091951.RV000.ZB3DBSIM.R0001315		MIDAM1	D.A.S.C.	2303
SYSUDUMP	SYS81119.T091951.SV000.ZB3DBSIM.R0001316		SCR102	D.A.S.D.	2314
EANDUMP	NULLFILE				

Figure H-1. GTDS Report Index, Title Page, and Input Card Deck Image (3 of 4)

```
                         INPUT CARD IMAGES

                                      INDEX - INPUT CARD IMAGES

COLUMN 1
        CONTROL    EPHEM                                                            NIMBUS-6    7505261
        ELEMENT1   2  1     1 -1464.417672106371    2304.060176451285    -6935.086498166348
        ELEMENT2              -.2613091377166648    5.8734113695524752    2.4016617707916466
        EPOCH                  760702.               034000.
        DRGTYPE    2  1     2  60.0
        OUTPUT     2  2     1  760702.               021000.               300.
        EGOPT
        OUTOPT              1  760702000000.         760702021000.         60.
        THRUST     1           1.0
        THRSTCOF   1  1        .0000001              -.000000000001
        ATTANG1    2        2  20.0                  -.0032
        ATTANG2    2        2  20.0                  .0001
        END
        FIN
        CONTROL    DATASIM                                                          NIMBUS-6    7505261
        DMOPT
        /AIM V     1        1  900.0                 -300000.0             1000000.0
        /AIM V     1  2     1    120.                  6.0
        /AIM R     1        2  900.0                 -300000.0             1000000.0
        /PMI T     1        3  900.0                 450000.0              1640000.0
        /PMI R     1        2  900.0                 450000.0              1540000.0
        /AIN V     1        1  900.0                 640000.0              130000.0
        /AIN T     1        3  900.0                 640000.0              130000.0
        /AIN R     1        2  900.0                 640000.0              130000.0
        /MARV      1        1  900.0                 0.0                   3360000.0
        /MARR      1        2  900.0                 0.0                   3360000.0
        /TEDT      1        3  900.0                 -650000.0             2950000.0
        /TEDR      1        2  900.0                 -650000.0             2950000.0
        /CIMV      1        1  900.0                 -450000.0             1600000.0
        /CIMR      1        2  900.0                 -450000.0             1600000.0
        END
        DCOPT
        DSPEA1     1  0        760702.               000100.               15.
        DSPEA2    20  1     1  760702.               020500.
        DSPEA3     2  2     1
        END
        FIN
        CONTROL    DATASIM                                                          NIMBUS-6    7505261
        DMOPT
        /AIM V     1        1  900.0                 -100000.0             1000000.0
        /AIM V     1  6  2       120.                  504.
        /AIM R     1        2  900.0                 -300000.0             1000000.0
        /PMI T     1        3  900.0                 450000.0              1540000.0
        /PMI R     1        2  900.0                 450000.0              1540000.0
        /AIN V     1        1  900.0                 600000.0              130000.0
        /AIN T     1        3  900.0                 640000.0              130000.0
        /AIN R     1        2  900.0                 640000.0              130000.0
        /MARV      1        1  900.0                 0.0                   3360000.0
        /MARR      1        2  900.0                 0.0                   3360000.0
        /TEDT      1        3  900.0                 -650000.0             2950000.0
        /TEDR      1        2  900.0                 -650000.0             2950000.0
        /CIMV      1        1  900.0                 -450000.0             1600000.0
        /CIMR      1        2  900.0                 -450000.0             1600000.0
        END
        DCOPT
        DSPEA1     3  0        760702.               000100.               15.
        DSPEA2    20  1     1  760702.               020500.
        DSPEA3     2  2     1
        END
        FIN
```

Figure H-1. GTDS Report Index, Title Page, and Input Card Deck Image (4 of 4)

As the input processor handles each of the input cards, it formats the fields and periodically generates interpretive or error messages. This output is used to quickly spot deck setup errors. Figure H-2 shows a sample of this output. If the user has suppressed this output, only error messages will be printed.

H.2 EPHEMERIS GENERATION (EPHEM) PROGRAM OUTPUT

The output from the GTDS Ephemeris Generation Program is divided into distinct reports:

- Initial Conditions Report
- Satellite Ephemeris Report
- Integration Statistics Summary Report
- Orbit Generator Summary Report

H.2.1 INITIAL CONDITIONS REPORT

The Initial Conditions Report is designed to reflect those options specified by the user as well as the run control parameters to be used by the EPHEM Program for this particular use. Figure H-3 shows a sample of this report.

The pertinent information in this report may be broken into the following categories:

- Spacecraft-dependent constants
- Orbit generator options
- Trajectory initial conditions (run time control)
- Initial satellite state
- Integrator options and parameters
- Sectioning-dependent parameters
- Impulsive maneuvers data
- Physical constants
- Output options
- SLP ephemeris options

```
                                        GTDS  EPHEM    PROGRAM

CONTROL EPHEM                                    NIMBUS-67E05201
CARD NO.=     1. CARD IMAGE ** ELEMENT1     2   1   1    -1464.4178721864      2304.0004764913     -6555.0004951663    **
CARD NO.=     2. CARD IMAGE ** ELEMENT2     0   0   0    -.26136513771686      6.0704124562240      2.4016617707920    **
CARD NO.=     3. CARD IMAGE ** EPOCH        0   0   0     760702.00000000      .0                  .0                  **
CARD NO.=     4. CARD IMAGE ** ORBTYPE      2   1   2     60.000000000000      .0                  .0                  **
CARD NO.=     5. CARD IMAGE ** OUTPUT       2   2   1     760702.00000000      21000.000000000     300.00000000000     **
CARD NO.=     6. CARD IMAGE ** OSOPT        0   0   0     .0                   .0                  .0                  **
START OF ORB GENE DECK PROCESSING
CARD NO.=     7. CARD IMAGE ** OUTOPT       0   0   1     760702000000.00      760702021000.00     60.000000000000     **
CARD NO.=     8. CARD IMAGE ** THRUST       1   0   0     1.0000000000000      .0                  .0                  **
CARD NO.=     9. CARD IMAGE ** THRSTCOF     1   1   0     .10000000000000D-06  -.10000000000000D-11 .0                 **
CARD NO.=    10. CARD IMAGE ** ATTANG1      2   0   2     20.000000000000      -.20000000000000D-03 .0                 **
CARD NO.=    11. CARD IMAGE ** ATTANG2      2   0   2     30.000000000000      .30000000000000D-03  .0                 **
CARD NO.=    12. CARD IMAGE ** END          0   0   0     .0                   .0                  .0                  **
NO ERRORS ENCOUNTERED IN ORB GENE DECK
CARD NO.=    13. CARD IMAGE ** FIN          0   0   0     .0                   .0                  .0                  **
NO ERRORS ENCOUNTERED IN CONTROL DECK
```

Figure H-2. Input Processor Interpretive/Error Message Output (1 of 4)

```
* * * *  PARTIAL BATCH DATA REPORT  * * * *

REQUEST TYPE - DATA              REQUEST ID - ZB3DBT1Y67523801

CONTROL VALUES - POLLING INTERVAL:        5 SECONDS
                 TIMEOUT PERIOD:         20 SECONDS

SELECTION CRITERIA -
      SATELLITE IDS:  7502701 7990101 7990301

    STATION ACRONYM: AAAA        TRACKING SYSTEM: AAAA

STALENESS BOUNDS -
      LOWER:          0. SECONDS    UPPER:         120. SECONDS

REQUEST RESOLUTION - PARTIAL BATCH DATA RECEIVED
```

Figure H-2. Input Processor Interpretive/Error Message Output (2 of 4)

```
GTDS  DC         PROGRAM

        GTDS INITIAL CONDITIONS REPORT

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

                TRAJECTORY INITIAL CONDITIONS
                (AS SPECIFIED BY INPUT DATA)
                    CASE NUMBER            1
EPOCH TIME GEOS-3               =MAR  1, 1979,  0 HRS.  0 MIN.   0.0   SEC
EPOCH TIME TDRS 1               =MAR  1, 1979,  0 HRS.  0 MIN.   0.0   SEC
EPOCH TIME TDRS 3               =MAR  1, 1979,  0 HRS.  0 MIN.   0.0   SEC
REFERENCE DATE OF INPUT         =MAR  1, 1979
OBSERVATION START TIME          =FEB 27, 1979,  0 HRS.  0 MIN.   0.0   SEC
OBSERVATION STOP  TIME          =MAR  3, 1979,  0 HRS.  0 MIN.   0.0   SEC
OBSERVATION INPUT SOURCE        =PARTIAL BATCH
                                =60-BYTE DATA BASE
```

Figure H-2. Input Processor Interpretive/Error Message Output (3 of 4)

```
*** 60-BYTE METRIC TRACKING DATA SOURCE SUMMARY FOR SATELLITE    7502701 ***
          60-BYTE REAL-TIME (PARTIAL BATCH) DATA FILE ACCESSED
SATELLITE 7502701:  NO DIRECT OBSERVATIONS FOUND WITHIN REQUESTED TIME SPAN

*** 60-BYTE METRIC TRACKING DATA SOURCE SUMMARY FOR SATELLITE    7990101 ***
          60-BYTE REAL-TIME (PARTIAL BATCH) DATA FILE ACCESSED

*** 60-BYTE METRIC TRACKING DATA SOURCE SUMMARY FOR SATELLITE    7990301 ***
          60-BYTE REAL-TIME (PARTIAL BATCH) DATA FILE ACCESSED
SATELLITE 7990301:  NO DIRECT OBSERVATIONS FOUND WITHIN REQUESTED TIME SPAN

*** 60-BYTE METRIC TRACKING DATA SOURCE SUMMARY FOR SATELLITE    7502701 ***
          60-BYTE REAL-TIME (PARTIAL BATCH) DATA FILE ACCESSED
```

Figure H-2. Input Processor Interpretive/Error Message Output (4 of 4)

```
                          GTDS  EPHEM    PROGRAM
                               GTDS INITIAL CONDITIONS REPORT
                                    INDEX - GTDS INITIAL CONDITIONS REPORT
                                     ORBIT GENERATION
                                GTDS  EPHEM    PROGRAM

CURRENT TIME APR 20, 1981, 17 HRS,49 MIN,  57.560 SEC                                          SCOPES NOT  IN USE
SATELLITE NAME          NIMBUS-6
SATELLITE NUMBER        7535201
SATELLITE CONFIGURATION:
     SATELLITE IS SPHERICAL
     DIAMETER                  =  0.16736560D+01  METERS        COEFFICIENT OF DRAG USED FOR THE RUN =  0.22000000D+01
     MASS                      =  0.20000000D+03  KG
     AERO VARIATION (AMOD)     =  0.0
     REFLECTIVITY CONSTANT     =  0.12000000D+01                AREA FOR RADIATION PRESSURE          =  0.22000000D+01 M**2

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . ORBIT GENERATION OPTIONS . . . . . . . . . . . . . . . . . . . . . . . .

ORBIT GENERATOR TYPE-
NUMERICAL INTEGRATION OF COWELL EQUATIONS OF MOTION

. . . . . . . . . . . . . . . . . . . . . . . . NO PARTIALS BEING COMPUTED . . . . . . . . . . . . . . . . . . . . . . . . . .


. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
                                   TRAJECTORY INITIAL CONDITIONS
                                   (AS SPECIFIED BY INPUT DATA)
                                      CASE NUMBER        1
                 EPOCH TIME                     =JULY 2, 1976,  0 HRS,  0 MIN,    0.0   SEC
                 END   TIME                     =JULY 2, 1976,  2 HRS, 10 MIN,    0.0   SEC
                 REFERENCE DATE OF INPUT        =JULY 2, 1976
                 TIME SPAN FOR THIS FLIGHT      =    0 DAYS          2.16667 HRS
                 PRINT START TIME               =JULY 2, 1976   0 HRS,  0 MIN,      0.0   SEC
                 PRINT INTERVAL                 =       300.000 SEC
```

Figure H-3. EPHEM Initial Conditions Report (1 of 6)

```
                              GTDS  EPHEM   PROGRAM
                                   GTDS INITIAL CONDITIONS REPORT
ADVANCED VECTOR REPORT  FOR   NIMBUS-6  7508201
INITIAL EPOCH AND ELEMENTS FROM              CARD FILE
EPOCH TIME=JULY 2, 1976,  0 HRS,  0 MIN,   0.0   SEC WILL BE USED AS ANCHOR POINT , NO EPOCH ADVANCE OCCURS.
CARTESIAN               ELEMENTS INPUT           CENTRAL BODY = EARTH          TRUE OF REFERENCE
CARTESIAN COORDINATES
        X     -0.14664178721063710+04         Y     0.22840284764512590+04         Z     -0.69850086551663480+04
        DX    -0.26130713771606460+00         DY    0.68784126958247950+01         DZ     0.24816617787915660+01
KEPLERIAN ELEMENTS
        SHA    0.74703721696841580+04         ECC   0.26824000007849590-02         INC    0.99584467825093420+02
        LAN    0.95653647698823710+02         AP    0.13211299504681890+03         MA     0.15630201133178070+03
SPHERICAL COORDINATES
        RA     0.12156039264173590+03         DEC  -0.66085934713540090+02         VPA    0.09530864154839020+02
        AZ     0.33240758319625090+03         RMAG  0.74967679942908410+04         VMAG   0.73282115281743697D+01
OTHER PARAMETERS (REFERENCED TO CENTRAL BODY AND COORDINATE FRAME OF INTEGRATION)
        EA     0.15644256579479 20+03         P     0.10726081245327050+03         SLR    0.74783163174407110+04
        PH     0.74503041075205810+04         APR   0.74904402316353330+04         PH     0.10801241072285810+04
        APH    0.11203002310393330+04         C3   -0.26650227846867430+02         TA     0.15680562725041790+03
        LAT   -0.66190789381754610+02         LON   0.20140043211075830+03         HGHT   0.11378447565047620+04
********************************************************************************************************
********************************************************************************************************
*                                     DEFINITIONS OF ABBREVIATIONS                                     *
*                                                                                                      *
*     X,Y,Z     = POSITION IN KM                                     EA     = ECCENTRIC ANOMALY IN DEGREES
*     DX,DY,DZ  = VELOCITY IN KM/SEC                                 P      = PERIOD IN MINUTES
*     SMA       = SEMI-MAJOR AXIS IN KM                              SLR    = SEMI-LATUS RECTUM IN KM
*     ECC       = ECCENTRICITY                                       PR     = PERIFOCAL RADIUS IN KM
*     INC       = INCLINATION IN DEGREES                             APR    = APOFOCAL RADIUS IN KM
*     RAAN      = RIGHT ASCENSION OF ASCENDING NODE DEGREES          PH     = MEAN PERIFOCAL HEIGHT IN KM
*     AP        = ARGUMENT OF PERIFOCUS IN DEGREES                   APH    = MEAN APOFOCAL HEIGHT IN KM
*     MA        = MEAN ANOMALY IN DEGREES                            C3     = ENERGY IN KM**2/SEC**2
*     RA        = RIGHT ASCENSION IN DEGREES                         TA     = TRUE ANOMALY IN DEGREES
*     DEC       = DECLINATION IN DEGREES                             LAT    = LATITUDE IN DEGREES
*     VPA       = VERTICAL FLIGHT PATH ANGLE IN DEG                  LON    = LONGITUDE IN DEGREES
*     AZ        = VELOCITY AZIMUTH IN DEGREES                        HGHT   = HEIGHT IN KM
*     RMAG      = MAGNITUDE OF POSITION VECTOR IN KM
*     VMAG      = MAGNITUDE OF VELOCITY VECTOR IN KM
********************************************************************************************************
```

Figure H-3. EPHEM Initial Conditions Report (2 of 6)

```
                                GTCS  EPHEM    PROGRAM
                                  GTDS INITIAL CONDITIONS REPORT

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * NUMERICAL INTEGRATION OPTIONS AND PARAMETERS * * * * * * * * * * * * * * * * * * * *
  NUMERICAL INTEGRATOR TYPE FOR STATE PROPAGATION-
      12 TH ORDER SUMMED COWELL/ADAMS PREDICT-PARTIAL CORRECT
* * * * * * * * * * * * * * * * * * * * * * * * INTEGRATION PARAMETERS * * * * * * * * * * * * * * * * * * * * * * * * * * *
           CONVERGENCE TOLERANCE FOR PREDICTOR-CORRECTOR ITERATIONS            =  0.5000D+00
           MAXIMUM NUMBER OF CORRECTOR ITERATIONS                              =     3
           CORRECTOR TOLERANCE FOR EQUATIONS OF MOTIONS MULTISTEP STARTER     =  0.1000D-11
           CORRECTOR TOLERANCE FOR VARIATIONAL EQUATIONS STARTER              =  0.1000D-11
           MAXIMUM NUMBER OF CORRECTOR ITERATIONS IN STARTER                  =    15

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * * * SECTIONING DEPENDENT PARAMETERS * * * * * * * * * * * * * * * * * * * * * *

                              TOTAL NUMBER OF SECTIONS    1
                               FORCE OPTIONS CONSIDERED

     SYSTEM OF INTEGRATION                        TRUE OF REFERENCE
     NAME OF ATMOSPHERIC DENSITY MODEL            NOT REQUIRED
     NAME OF EARTH POTENTIAL FIELD MODEL                GEMS 21X21 (DEFAULT)
     NAME OF LUNAR POTENTIAL FIELD MODEL          NOT REQUIRED
     NO SECTION MODEL RETRIEVED FROM PERM FILES(DEFAULT AND CARD INPUT USED)

                 SECTION  1
INTEG STP MODE     FIXED
STEP SIZE (SEC)       60.0
HARMONICS          ZON-TESL
    MAX DEGREE        4
    MAX ORDER         4
RESONANT POTENTIAL NO
        ORDER        13
CENTRAL BODY       EARTH
NON-CENT BODY1     MOON
NON-CENT BODY2     SUN
2-BODY MOTION      NO
SOL RAD PRESS      NO
DRAG               NO
POLAR MOTION       NO
THRUST             YES
INTEG RESTART     ALL-STEP

 ORBIT TYPE       =   COWELL

                                  CROSSOVER CONDITION BY SECTION

   MORE THAN ONE CONDITION MAY BE LISTED. ANY ONE OF WHICH MAY CAUSE SECTIONING.   THE FIRST CONDITION TO BE
   SATISFIED WILL BE THE CROSSOVER CONDITION BETWEEN ANY TWO ADJACENT SECTIONS.  WHEN VEHICLE IMPACTS UPON
   CENTRAL BODY OR WHEN END OF PRINT ARC ( 760702  210000.000 ) IS REACHED, RUN WILL TERMINATE.

  FROM SECTION  1 TO TERMINATION

   (1) SECTIONING DUE TO TIME FROM EPOCH..... 0.72000000D+06 SECONDS

* * * * * * * * * * * * * * * * * * * * * * * * * MANEUVERS DATA * * * * * * * * * * * * * * * * * * * * * * * * * *
                                              0 MANEUVERS THIS FLIGHT
```

Figure H-3. EPHEM Initial Conditions Report (3 of 6)

```
                    GTDS  EPHEM    PROGRAM
                         GTDS INITIAL CONDITIONS REPORT

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * PHYSICAL CONSTANTS* * * * * * * * * * * * * * * * *

                         UNIVERSAL GRAVITATIONAL CONSTANT   =   0.667300000D-22 KM**3/(SEC**2)(GRAM)
                         ASTRONOMICAL UNIT                  =   0.149597890D+09 KM
                         SOLAR RADIATION PRESSURE           =   0.450000000E-02 (KG/SEC**2)/KM

        CONSTANTS OF BODIES CONSIDERED THIS FLIGHT--
GRAV CONST(KM**3/SEC**2)   EARTH   0.398600064D+06     MOON    0.490277800D+04     SUN    0.132715440D+12
MEAN EQUATORIAL RADIUS(KM) EARTH   0.637814000D+04     MOON    0.173800000D+04     SUN    0.695952000D+06
ROTATION RATE(RAD/SEC)     EARTH   0.729211590D-04     MOON    0.266169550D-05     SUN    0.0
SPHERE OF INFLUENCE(KM)    EARTH   0.925000000D+06     MOON    0.666600000D+05     SUN    0.0
INVERSE FLATTENING COEFF   EARTH   0.298250000D+03     MOON    0.100000000D+31     SUN    0.100000000D+31
GREENWICH HOUR ANGLE       EARTH   0.428571370D+01

          HARMONIC COEFFICIENTS          EARTH                              MAXIMUM DEGREE :   4
                                                                            MAXIMUM ORDER  :   4
  ZONALS
  INDEX         VALUE              INDEX           VALUE             INDEX          VALUE           INDEX        VALUE
  N  M                             N  M                              N  M                           N  M
  2  0 -.108262710000000000D-02    3  0 0.253000000000000000D-05     4  0 0.162421000000000000D-05

  SECTORALS AND TESSERALS
  INDEX                   VALUE                                      INDEX                VALUE
  N  M          C                      S                             N  M         C                       S
  2  1  -.270385570000000000D-09  -.823814640000000000D-09           2  2  0.157114230000000000D-05  -.902313370000000000D-06
  3  1   0.215078540000000000D-05  0.272478740000000000D-06          3  2  0.304460250000000000D-06  -.212852500000000000D-06
  3  3   0.575660030000000000D-07  0.196810770000000000D-06          4  1  -.508227490000000000D-06  -.441280150000000000D-06
  4  2   0.782425150000000000D-07  0.148165580000000000D-06          4  3  0.590737490000000000D-07  -.121400730000000000D-07
  4  4  -.415424930000000000D-08   0.631635410000000000D-08

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                                          OUTPUT OPTIONS
SECTION DEPENDENT OPTIONS
                 SECTION  1
EPHEM   REPORT      FULL
CENTRAL BODY        EARTH

REF COORD SYST     TRU-DATE
                   INERTIAL

MAP INIT STATE COV MATRIX
                 NO

PRINT FREQUENCY
                 300.0 SECONDS

PRINT AT END OF EACH SECTION
                 NO

COOR. SYSTEM OF OUTPUT PARTIALS
                 CARTESIAN

OUTPUT DATA SETS REQUESTED

                 EPHEM TAPE OUTPUT NOT REQUESTED

                 ORB1  TAPE OUTPUT NOT REQUESTED

                 ORBIT TAPE OUTPUT WILL BE ON UNIT 20
                        START TIME OF ORBIT FILE    =JULY 2, 1976,  0 HRS,  0 MIN,   0.0   SEC
                        END TIME OF ORBIT FILE      =JULY 2, 1976,  2 HRS, 10 MIN,   0.0   SEC

PERMANENT FILE REPORT REQUESTED
                 NONE AT THIS TIME
```

Figure H-3. EPHEM Initial Conditions Report (4 of 6)

```
                    GTDS  EPHEM    PROGRAM
                          GTDS INITIAL CONDITIONS REPORT

WORKING FILE  REPORTS REQUESTED
                NONE AT THIS TIME
*****************************************************************************************************
* * * * * * * * * * * * * * * * * * * * * *END OF GTDS INITIAL CONDITIONS REPORT * * * * * * * * * * * * * * * * * * * * * * *
```

Figure H-3. EPHEM Initial Conditions Report (5 of 6)

```
                 GTDS  EPHEM    PROGRAM
        GTDS SLP EPHEMERIS   SUMMARY REPORT
                        INTER - SLP EPHEMERIS   SUMMARY REPORT

DATE OF REPORT IS APR  29,1981
START TIME OF DATA                                  = JAN   1,1974
NUMBER OF DAYS OF DATA                              =   4400
FINAL TIME OF DATA                                  = JAN  18,1986
NUMBER OF BODIES REPRESENTED BY CURVE-FITS          =  6
CENTRAL BODY FOR POLYNOMIAL COEFFICIENTS            = EARTH
FAST BODY FOR POLYNOMIAL COEFFICIENTS               = MOON
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = SUN
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = MARS
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = JUPITER
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = SATURN
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = URANUS
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = MERCURY
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS             = VENUS
DEGREE OF POLYNOMIALS FOR ROTATIONMATRIX            =   5
DEGREE OF POLYNOMIALS FOR FAST BODY POSITION        =  19
DEGREE OF POLYNOMIALS FOR FAST BODY VELOCITY        =  12
DEGREE OF POLYNOMIALS FOR SLOW BODY POSITION        =   9
NUMBER OF DAYS PER CURVE FIT                        =  20
COORDINATE SYSTEM REFERENCED TO TRUE OF DATE
```

Figure H-3. EPHEM Initial Conditions Report (6 of 6)

Three key areas of this report that should always be checked are (1) the run time control block, which reflects the epoch, run start and end time, and reference time of input; (2) the initial state, which reflects the specified epoch state, of the vehicle; and (3) the force model options to be used. The force model parameters are found in the section-dependent parameter block.

H.2.2 SATELLITE EPHEMERIS REPORT

The Satellite Ephemeris Report is controlled by user options specified on the OUTPUT keyword card. Figure H-4 contains an example of this report. Its primary components are

- Date (time of the output point)
- Central body and coordinate reference
- Vehicle state
- Partial derivatives (if specified)

Beginning with epoch, the program will generate output at each point specified by the user on the OUTPUT keyword card. The times printed are Universal Time Coordinated (UTC). Output will also be generated at the end time of each section (including the final section, which is the run end time) and at the beginning of each new section.

The coordinate frame of the output may also be specified by the user on the OUTPUT keyword card. The output central body will always include at least the central body of the integrator. The user has the option of specifying either the inertial frame or a body-fixed frame; the user may also specify mean-of-1950.0, true-of-date, or true-of-reference coordinate system.

```
                                   GTCS  EPHEM    PROGRAM
                              GTDS SATELLITE EPHEM REPORT  SECTION  1
                                             INDEX - GTDS SATELLITE EPHEM REPORT  SECTION  1
ENTERED OHB2, NEC=      0

**************************************************************************************************
DATE    JULY  2, 1976    0HRS      0MINS      0.0  SECS  (JULIAN DATE = 2442961.5000)
ELAPSED TIME FROM EPOCH =     0 DAYS     0 HRS     0 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                  INERTIAL SYSTEM    TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -1464.417672      Y      2324.060476      Z    -6955.686495     DX   -.2613051377     DY    6.070412696     DZ    3.401061771
SMA   7470.372170      ECC   .26074000010-02   INC   99.95446753     RAAN  98.69264760     AP    133.1169558     MA    156.3020113
EA    156.4442570      P     1.787000208       SLR   7470.318317     PR     7458.304108     APR  7458.440232     PH    1000.164108
APH   1120.300232      C3   -26.66022755       TA    156.5056273     LAT  -60.15676536     LON  201.4004321     HGT   1137.044787
R     7496.767594      V     7.202779287       FA    121.5603926     DEC  -60.06593471     VPA   89.93622418     AZ    332.4075832

**************************************************************************************************
DATE    JULY  2, 1976    0HRS      5MINS      0.0  SECS  (JULIAN DATE = 2442961.5035)
ELAPSED TIME FROM EPOCH =     0 DAYS     0 HRS     5 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                  INERTIAL SYSTEM    TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -1400.055675      Y      4315.701622      Z    -5951.176333     DX    .1578043238     DY    5.916428026     DZ    4.263782149
SMA   7482.494426      ECC   .23384182340-02   INC   99.98176617     RAAN  98.65686133     AP    144.6674227     MA    159.3170767
EA    159.3642150      P     1.789270629       SLR   7482.453510     PR     7464.657247     APR  7499.551465     PH    1086.857247
APH   1121.851665      C3   -26.63554540       TA    159.4114610     LAT  -52.66176362     LON  187.5160718     HGT   1124.217789
R     7498.868587      V     7.282749614       FA    100.9285603     DEC  -52.68413658     VPA   89.15876183     AZ    343.4083093

**************************************************************************************************
DATE    JULY  2, 1976    0HRS     10MINS      0.0  SECS  (JULIAN DATE = 2442961.5069)
ELAPSED TIME FROM EPOCH =     0 DAYS     0 HRS    10 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                  INERTIAL SYSTEM    TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -1370.985266      Y      5003.020276      Z    -4444.637516     DX    .5641954040     DY    4.462866410     DZ    6.120779710
SMA   7487.486014      ECC   .17554941570-02   INC   99.54851710     RAAN  98.70224637     AP    156.7612336     MA    166.2131210
EA    166.2370501      P     1.791069376       SLR   7487.468539     PR     7474.341771     APR  7506.630286     PH    1096.201771
APH   1122.450256      C3   -26.61770062       TA    166.2605509     LAT  -36.45775582     LON  180.4456056     HGT   1129.642356
R     7500.282663      V     7.283041236       FA    103.1164147     DEC  -36.34161305     VPA   89.57607066     AZ    347.6149766

**************************************************************************************************
DATE    JULY  2, 1976    0HRS     15MINS      0.0  SECS  (JULIAN DATE = 2442961.5104)
ELAPSED TIME FROM EPOCH =     0 DAYS     0 HRS    15 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                  INERTIAL SYSTEM    TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -1146.265453      Y      6955.942683      Z    -2562.325121     DX    .9233627576     DY    2.630662130     DZ    6.730920540
SMA   7491.734262      ECC   .11931200010-02   INC   99.54683050     RAAN  98.70378093     AP    124.2477369     MA    105.4718035
EA    105.4652527      P     1.792923155       SLR   7491.653617     PR     7482.765779     APR  7500.648704     PH    1104.625779
APH   1122.502764      C3   -26.60280125      TA    105.4587657     LAT  -20.08061471     LON  178.4375370     HGT   1124.966740
R     7500.602150      V     7.285556083       FA    56.32616220     DEC  -19.97636360     VPA   90.00621007     AZ    349.4103925

**************************************************************************************************
DATE    JULY  2, 1976    0HRS     20MINS      0.0  SECS  (JULIAN DATE = 2442961.5139)
ELAPSED TIME FROM EPOCH =     0 DAYS     0 HRS    20 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                  INERTIAL SYSTEM    TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -824.7366151      Y      7429.031306      Z    -463.1416796     DX   1.204965674     DY    .8144471777     DZ    7.164114915
SMA   7493.756673      ECC   .10562902500-02   INC   99.94466238     RAAN  98.70468220     AP    138.2517692     MA    221.1932427
EA    221.1634162      P     1.763320154       SLR   7453.150309     PR     7485.843606     APR  7801.674256     PH    1107.703066
APH   1123.534256      C3   -26.69550010      TA    221.1136635     LAT  -3.260745644     LON  171.1620016     HGT   1121.660554
R     7499.718711      V     7.287410909       FA    96.32562144     DEC  -3.240526691     VPA   90.03562761     AZ    350.6361237


                                        UNITS FOR INFORMATION
               DISTANCES ARE IN KILOMETERS                      ANGLES          ARE IN DEGREES
               RATES     ARE IN KM/SEC                          TIME(PERIOD) IS IN HOURS
```

Figure H-4. Satellite Ephemeris Report (1 of 2)

```
                                        GTDS  LPFEM    PROGRAM

                                 GTDS   SATELLITE EPHEMERIS REPORT    SECTION  1

***********************************************************************************************************************
DATE    JULY  2, 1976     2HRS      5MINS      0.0  SECS  (JULIAN DATE = 2442961.58681)
ELAPSED TIME FROM EPOCH =     0 DAYS     2 HRS      5 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                         INERTIAL SYSTEM     TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -1807.992578        Y      7270.950613          Z    -1545.383765       DR     1.67119E038      DV     1.627156626       DZ    3.010312469
SMA  7494.088112         ECC  .10660539610D-02      INC    99.64487418       RAAN   95.77725402     AP     148.6386534       MA    183.3346118
EA   202.3115133         P      1.793638813          SLA  7454.675601        FA    7426.143574      APR   7503.032280       PH    1100.003074
APH  1123.892253         C3   -26.59433903           TA    202.2885064       LAT  -11.95412728      LGN    146.3532023       FGT   1124.208612
R    7501.437457         V      7.285960108          FA    57.89272670       DEC  -11.86872866      VPA    90.02362022       AZ    249.8348368

ENDED ORBIT FILE

***********************************************************************************************************************
DATE    JULY  2, 1976     2HRS     10MINS      0.0  SECS  (JULIAN DATE = 2442961.59031)
ELAPSED TIME FROM EPOCH =     0 DAYS     2 HRS     10 MINS      0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                         INERTIAL SYSTEM     TRUE EQUATOR AND EQUINOX OF JULY 2  1976
X    -640.5886647        Y      7440.035853          Z     555.1448675       DR     1.307884551      DV    -.4625812150       DZ    1.154278822
SMA  7494.781887         ECC  .11935279290D-02      INC    99.54443119       RAAN   92.77737140     AP     125.7477846       MA    234.0497855
EA   234.9338139         P      1.793627663          SLA  7454.771210        FH    7482.036655      APR   7503.737118       PH    1107.496655
APH  1125.587118         C3   -26.55127726           TA    234.8776614       LAT    4.521876850      LON    142.2216257       FGT   1121.916567
H    7499.921122         V      7.287720316          MA    94.57606650       DEC    4.254866156      VPA    90.05287166       AZ    280.0237166

                          **********    END OF FLIGHT ID SECTION   1 **********
```

Figure H-4. Satellite Ephemeris Report (2 of 2)

Elements other than Cartesian are always referenced to the inertial frame for Earth-centered output. For output with a central body other than Earth, the non-Cartesian elements are always referenced to a pseudo-body-fixed frame (e.g., lunar output of non-Cartesian elements is always selenographic).

The extent of output at each request may be specified by the user via the OUTPUT and LIFETIME keywords. The three basic formats available for each requested output central body are as follows:

- Basic state output (Figure H-5)--includes Cartesian elements, magnitudes of the position and velocity vectors (R and V), latitude (LAT), longitude (LON), and height (HGT)
- Extended output (default)--includes Cartesian, Keplerian, spherical, and flight parameters (Figure H-4)
- Lifetime study output (Figure H-6)--includes a one-line output consisting of apofocal radius, perifocal radius, inclination, and eccentricity. This example has input from the Permanent Elements File; the last EPHEM Final Report is included with the Lifetime Study Report.

The option is available to the user to include output from various central bodies for each output block.

If the user has specified that any partial derivatives are to be computed and a report is requested via the OUTPART keyword card during the run, the partial derivatives will be printed as part of the Satellite Ephemeris Report. (Keplerian partial derivatives are shown in Figure H-5.)

```
EM2-EPH2-CONELL.NUMERICAL KEPLERIAN STATE PARTIALS.COVARIANCE MAP

GTDS   SATELLITE EPHEMERIS REPORT   SECTION 1

****************************************************************************************************
DATE   DEC 25, 1979   22HRS   30MINS   0.0 SECS (JULIAN DATE = 2444233.43750)
ELAPSED TIME FROM EPOCH =   0 DAYS   1 HRS   30 MINS   0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH           INERTIAL SYSTEM   MEAN EQUATOR AND EQUINOX OF 1950.
X    1731.620035      Y   -6866.076816    Z    1732.753766    DX  -1.572208806     DY   1.306658691      DZ   7.003060038
R    7240.055505      V    7.508232186    LAT  13.83187183    LON  212.0226683     HGT  811.1201274

OUTPUT CENTRAL BODY IS SUN             INERTIAL SYSTEM   MEAN EQUATOR AND EQUINOX OF 1950.
X   -0024029.002      Y   134776920.8     Z    58465162.40    DX  -31.00368267     DY  -.2023812901     DZ   0.401000230
R    147122538.3      V    32.44165412    LAT  .0             LON  .0              HGT  .0

                 SMA              ECC              INC              LAN              AP               MA
SMA(0)      0.10083D+01      0.29790D-06     -0.63280D-07     -0.36250D-06     -0.15470D-02      0.82010D-03
ECC(0)     -0.40200D+02     -0.98400D+00      0.27620D-03      0.23180D-03     -0.83540D+03      0.83860D+03
INC(0)     -0.37370D+01     -0.52160D-03      0.99920D+00      0.69630D-02     -0.37380D+00      0.30390D+00
LAN(0)     -0.40615E-01     -0.18400D-04      0.11670D-04      0.10000D+01     -0.32550D-01      0.32670D-01
AP(0)       0.60580D+01      0.88040D-03     -0.70490D-04     -0.28940D-03      0.34870D+01     -0.24710D+01
MA(0)       0.60440D+01      0.74290D-03     -0.60970D-04     -0.25000D-03      0.42730D+01     -0.32800D+01

****************************************************************************************************
DATE   DEC 25, 1979   23HRS   0MINS   0.0 SECS (JULIAN DATE = 2444233.45833)
ELAPSED TIME FROM EPOCH =   0 DAYS   2 HRS   0 MINS   0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH           INERTIAL SYSTEM   MEAN EQUATOR AND EQUINOX OF 1950.
X   -1636.207567      Y    3063.402186    Z    6323.493688    DX  -1.385944382     DY   6.386649264      DZ  -3.466726381
R    7280.015060      V    7.308855553    LAT  60.31650512    LON  43.46615040     HGT  826.0082631

OUTPUT CENTRAL BODY IS SUN             INERTIAL SYSTEM   MEAN EQUATOR AND EQUINOX OF 1950.
X   -0082115.016      Y   134703501.0     Z    58448833.56    DX  -31.03611022     DY   0.77640011       DZ  -0.403168377
R    147133001.6      V    32.18637787    LAT  .0             LON  .0              HGT  .0

                 SMA              ECC              INC              LAN              AP               MA
SMA(0)      0.97780D+00      0.66910D-06      0.23780D-06     -0.91110D-06     -0.20820D-02      0.13840D-02
ECC(0)     -0.66450D+02     -0.27440D+00      0.30210D-03     -0.74160D-03     -0.71270D+03      0.71280D+03
INC(0)      0.61190D+00     -0.90450D-03      0.10000D+01      0.10070D-01     -0.26000D+00      0.27440D+00
LAN(0)     -0.92445E-01      0.24840D-04      0.13630D-04      0.10000D+01     -0.86210D-01      0.86340D-01
AP(0)       0.29620D+02     -0.13560D-02     -0.31340D-03      0.17770D-04      0.33810D+01     -0.22840D+01
MA(0)       0.29580D+02     -0.28280D-02     -0.31350D-03      0.10210D-04      0.33900D+01     -0.24820D+01

****************************************************************************************************
DATE   DEC 25, 1979   23HRS   30MINS   0.0 SECS (JULIAN DATE = 2444233.47917)
ELAPSED TIME FROM EPOCH =   0 DAYS   2 HRS   30 MINS   0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH           INERTIAL SYSTEM   MEAN EQUATOR AND EQUINOX OF 1950.
X   -760.6679088      Y    5327.220463    Z   -4922.651603    DX   2.230107026     DY  -6.609830780      DZ  -0.337163938
R    7203.377030      V    7.369163678    LAT -42.82871788    LON  11.74996503     HGT  825.0025688

OUTPUT CENTRAL BODY IS SUN             INERTIAL SYSTEM   MEAN EQUATOR AND EQUINOX OF 1950.
X   -4135352.527      Y   134703316.2     Z    58435900.52    DX  -27.99904473     DY  -6.220600287      DZ  -0.027900000
R    147130870.8      V    29.31884718    LAT  .0             LON  .0              HGT  .0

                 SMA              ECC              INC              LAN              AP               MA
SMA(0)      0.10320D+01     -0.40440D-05     -0.36930D-06     -0.87090D-06     -0.27880D-02      0.87960D-03
ECC(0)     -0.31330D+02     -0.83650D+00      0.27640D-04     -0.19710D-03     -0.81220D+03      0.81820D+03
INC(0)     -0.13850D+01     -0.12820D-02      0.99970D+00      0.11130D-01     -0.44980D+00      0.55350D+00
LAN(0)     -0.34878E+00      0.58718E-05      0.63610D-05      0.10000D+01     -0.62210D-01      0.62760D-01
AP(0)      -0.14920D+01      0.26070D-02      0.44610D-04     -0.88440D-04      0.31870D+01     -0.22140D+01
MA(0)      -0.19385E+01      0.23070D-02      0.44060D-04     -0.87490D-04      0.37240D+01     -0.27410D+01

                                      UNITS FOR INFORMATION
DISTANCES ARE IN KILOMETERS                                    ANGLES         ARE IN DEGREES
RATES     ARE IN KM/SEC                                        TIME(PERIOD) IS IN HOURS
```

Figure H-5. Basic State Output With Keplerian Partial Derivatives

GIDS EPHEM PROGRAM PAGE 21

GIDS SATELLITE EPHEM MEMORY SECTION 1

INDEX - GIDS SATELLITE EPHEM MEMORY SECTION 1

Figure H-6. Lifetime Study Output (1 of 4)

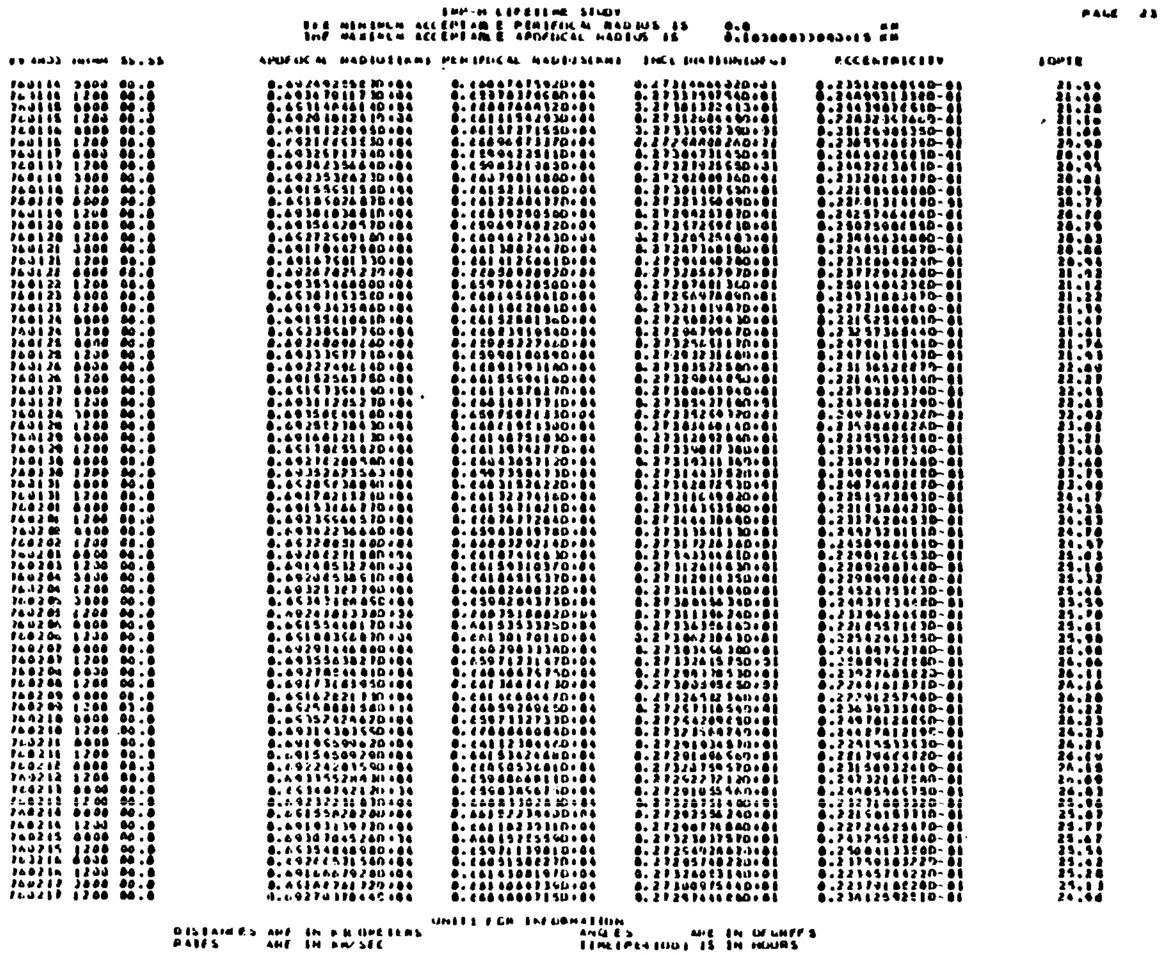


Figure H-6. Lifetime Study Output (2 of 4)

```
                                   GTDS  EPHEM   PROGRAM                                            PAGE   24
                                GTDS   SATELLITE EPHEMERIS REPORT   SECTION  1
*****************************************************************************************************************
DATE   FEB  18, 1976   0HRS    0MINS    0.0  SECS  (JULIAN DATE = 2442826.50000)
ELAPSED TIME FROM EPOCH =  107 DAYS   0 HRS  .  0 MINS    0.000 SECS
FLIGHT CENTRAL BODY IS EARTH

OUTPUT CENTRAL BODY IS EARTH                                   TRUE EQUATOR AND EQUINOX OF DATE
X     3250.666543     Y   -5343.117414     Z    -0.402896425     DX     6.653766352    DY    3.466844905     DZ  -.3571853724
SMA   6766.338616     ECC  .2490638461D-01 INC   2.2029273650    RAAN  117.0856950     AP   173.1279087      MA    6.97869637
EA    6.205872292     P    1.538646151     SLR  6762.110876      PR    6597.204586     APR  6935.472646      PH  219.0765876
APH   557.3326442     C3  -29.45467726     TA    6.494665407     LAT -.7413011160D-01  LON  152.4059523      HGT 220.8290131
R     6598.065778     V    7.767501225     FA  295.5857068       DEC -.7365040222D-01  VPA  85.79386047      AZ   92.40100216

                       ***********   END OF FLIGHT IN SECTION  1**********
```

Figure H-6. Lifetime Study Output (3 of 4)

```
GTDS  EPHEM     PROGRAM                                              PAGE   25

CHMIT GENERATOR FINAL REPORT

             INDEX - CHMIT GENERATION FINAL REPORT

SATELLITE NAME
SATELLITE NUMBER              7600901
RUN REFERENCE DATE        NOV   3, 1978    0 HRS     0 MINS      0.0    SECONDS
RUN EPOCH DATE            NOV   3, 1978    0 HRS     0 MINS      0.0    SECONDS
RUN FINAL TIME            FEB  18, 1979    0 HRS     0 MINS      0.0    SECONDS
TOTAL TIME OF FLIGHT      107 DAYS    0 HRS     3 MINS    1.03000 SECONDS
CAUSE OF TERMINATION      SPECIFIED TIME OF FLIGHT REACHED

                          ***END CONDITIONS***
CENTRAL BODY IS EARTH   (INERTIAL SYSTEM)                        TRUE OF REFERENCE
X     [illegible]               V     -0.57[illegible]          Z     -0.[illegible]
DX    [illegible]               DV     0.3[illegible]           DZ    -0.3[illegible]

SMA   [illegible]               ECC    [illegible]              INC    [illegible]
LAN   [illegible]               AP     [illegible]              MA     [illegible]
EA    [illegible]               P      [illegible]              SLR    [illegible]
PP    [illegible]               APH    [illegible]              PH     [illegible]
APH   [illegible]               C3    -0.[illegible]            TA     [illegible]

RA    [illegible]               DEC   -0.[illegible]            VPA    [illegible]
AZ    [illegible]               VMAG   [illegible]              VMAG   [illegible]

                          ***INITIAL CONDITIONS***
CENTRAL BODY IS EARTH   (INERTIAL SYSTEM)                        TRUE OF REFERENCE
X     [illegible]               V     -0.[illegible]            Z      [illegible]
DX    [illegible]               DV     [illegible]              DZ     [illegible]

SMA   [illegible]               ECC    [illegible]              INC    [illegible]
LAN   [illegible]               AP     [illegible]              MA     [illegible]
EA    [illegible]               P      [illegible]              SLR    [illegible]
PA    [illegible]               APH    [illegible]              PH     [illegible]
APH   [illegible]               C3    -0.[illegible]            TA     [illegible]

RA    [illegible]               DEC    [illegible]              VPA    [illegible]
AZ    [illegible]               VMAG   [illegible]              VMAG   [illegible]

                       *** SECTIONING SUMMARY ***
           NUMBER OF SECTIONS SCHEDULED =   1
           NUMBER OF SECTIONS COMPLETED =   1
SECTION CENTRAL BODY    TIME OF CROSSING          TIME INTO FLIGHT        CAUSE OF CROSSING
                          H   M    S              D   H    S
   1      EARTH     FEB 18   0   0   1.000     2500   0   1.000     SPECIFIED TIME OF FLIGHT REACHED

                    *** FILE GENERATION SUMMARY ***
           NO FILES HAVE BEEN GENERATED

                *** NUMBER OF GTDS ERRORS ENCOUNTERED=     0**

** END LIFETIME STUDY CASE   15 THROUGH   16
```

Figure H-6. Lifetime Study Output (4 of 4)

In addition, if the user has requested the mapping of the initial state covariance matrix via the keyword card STATEPAR, the final state covariance matrix will be reported (Figure H-7) immediately after the Satellite Ephemeris Report.

H.2.3 INTEGRATION STATISTICS SUMMARY REPORT

Figure H-8 is an example of the Integration Statistics Summary Report. This report, generated at the conclusion of every EPHEM Program run, is designed to reflect the general performance of the integrator. The information is well labeled and consists of items such as total number of steps, number of step-size changes, and average step size.

H.2.4 EPHEMERIS GENERATION FINAL REPORT

Figure H-9 is an example of the Ephemeris Generation Final Report. This report is printed at the conclusion of every Ephemeris Generation Program run. It is a short, one-page history of the run. The information is well labeled and contains such items as run start and end time and run starting and ending states. Another pertinent item available in this report is the sectioning summary. This block contains a history of any sectioning that occurred, including well-labeled items such as time of sectioning, reason for sectioning, and elapsed time from epoch when sectioning occurred.

H.2.5 KEPLERIAN ELEMENTS HISTORY PLOTS

If an EPHEM File has been generated in an EPHEM run, it is possible to request elements history plots via HISTPLOT and HSTSCALE keyword cards. A summary of the EPHEM File to be plotted is always reported, as shown in Figure H-10. Figure H-11 is an example of the plot of the semimajor axis in kilometers over a time period.

RESULT OF THE MATRIX MAPPING OPTION

FINAL TIME IS JAN 3, 1980 10 HRS 0 MINS 0.0 SECONDS (JULIAN DATE= [illegible])
TIME FROM EPOCH 0 DAYS 13 HRS 0 MINS 0.0 SECS

FINAL STATE COVARIANCE MATRIX

	x	y	z	ẋ	ẏ	ż
x	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
y	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
z	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ẋ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ẏ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ż	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-7. Covariance Matrix Map

```
CN2-EPH1-CONFLL,ANALYTIC SPHERICAL STATE PARTIALS,COVARIANCE MAP
          INTEGRATION STATISTICS REPORT
                    INDEX - INTEGRATION STATISTICS REPORT

    TOTAL NUMBER OF STEPS                     =        4916
    ORDER OF INTEGRATION USED                 =          12
    AVERAGE NO. PRED. CORR.ITERATIONS         =     1.00000
    TOTAL STEP CHANGES IN STARTERS            =           0
    TOTAL STEP CHANGES IN CSTEP               =           1
    NO. CORRECTOR ITERATIONS IN NSTART(E.M.)  =           7
    NO. CORRECTOR ITERATIONS IN NSTART(V.E.)  =           0
    NO.TIMES FORCES CALLED FOR FULL MODEL=             4916
    INTEGRATION STEP MODE WAS FIXED STEP
    WITH A STEPSIZE OF      150.0 SECONDS
```

Figure H-8. Integration Statistics Summary Report

```
                         GTCS  EPHEM   PROGRAM
                    ORBIT GENERATOR FINAL REPORT
                              INDEX - ORBIT GENERATOR FINAL REPORT

         SATELLITE NAME              NIMBUS-6
         SATELLITE NUMBER              7505201
         RUN REFERENCE DATE          JULY  2, 1976    0 HRS    0 MINS    0.0    SECONDS
         RUN EPOCH DATE              JULY  2, 1976    0 HRS    0 MINS    0.0    SECONDS
         RUN FINAL TIME              JULY  2, 1976    2 HRS   10 MINS    0.0    SECONDS
         TOTAL TIME OF FLIGHT          0 DAYS    2 HRS    10 MINS    0.0    SECONDS
         CAUSE OF TERMINATION        SPECIFIED TIME OF FLIGHT REACHED

                              ***END CONDITIONS***
CENTRAL BODY IS EARTH   (INERTIAL SYSTEM)                              TRUE OF REFERENCE
X     [illegible]              Y      [illegible]                      Z     [illegible]
DX    [illegible]              DY     [illegible]                      DZ    [illegible]

SMA   [illegible]              ECC    [illegible]                      INC   [illegible]
LAN   [illegible]              AP     [illegible]                      RA    [illegible]
EA    [illegible]              P      [illegible]                      SLR   [illegible]
PA    [illegible]              APH    [illegible]                      PM    [illegible]
APH   [illegible]              C3     [illegible]                      TA    [illegible]

HA    [illegible]              DEC    [illegible]                      VPA   [illegible]
AZ    [illegible]              RMAG   [illegible]                      VMAG  [illegible]

                              ***INITIAL CONDITIONS***
CENTRAL BODY IS EARTH   (INERTIAL SYSTEM)                              TRUE OF REFERENCE
X     [illegible]              Y      [illegible]                      Z     [illegible]
DX    [illegible]              DY     [illegible]                      DZ    [illegible]

SMA   [illegible]              ECC    [illegible]                      INC   [illegible]
LAN   [illegible]              AP     [illegible]                      RA    [illegible]
EA    [illegible]              P      [illegible]                      SLR   [illegible]
PA    [illegible]              APH    [illegible]                      PM    [illegible]
APH   [illegible]              C3     [illegible]                      TA    [illegible]

HA    [illegible]              DEC    [illegible]                      VPA   [illegible]
AZ    [illegible]              RMAG   [illegible]                      VMAG  [illegible]

                              *** SECTIONING SUMMARY ***
               NUMBER OF SECTIONS SCHEDULED =     1
               NUMBER OF SECTIONS COMPLETED =     1
SECTION CENTRAL BODY     TIME OF CROSSING           TIME INTO FLIGHT        CAUSE OF CROSSING
                                H   M     S            H   M    S
   1        EARTH       JULY  2   2   9   60.000       2   9  60.000       SPECIFIED TIME OF FLIGHT REACHED

                              *** FILE GENERATION SUMMARY ***

               A NEW LEVEL HAS BEEN ADDED TO A DIRECT CARD FILE
               START TIME OF THE FILE =     760701235960.000
               END TIME OF THE FILE =       760702021000.000

                       *** NUMBER OF GTCS ERRORS ENCOUNTERED=     0**
```

Figure H-9. Ephemeris Generation Final Report

```
                                                                        PAGE  26
[illegible]    SATELLITE ID

                     ******* EPHEMERIS ELEMENTS HISTORIES FILES *******

START AT   [illegible] HHMMSS.SSS   END AT OR BEFORE  [illegible] HHMMSS.SSS   TIME INTERVAL BETWEEN DATA ITEMS [illegible]


EPHEM FILE ON UNIT 24.  PROVIDES  401 DATA

CENTRAL BODY IS EARTH
COORDINATE SYSTEM IS IN TOD

DATA RECORDS START AT   [illegible] HHMMSS.SSS   TIME INTERVAL BETWEEN DATA ITEMS [illegible]
```

Figure H-10. Keplerian Elements History Plot Summary

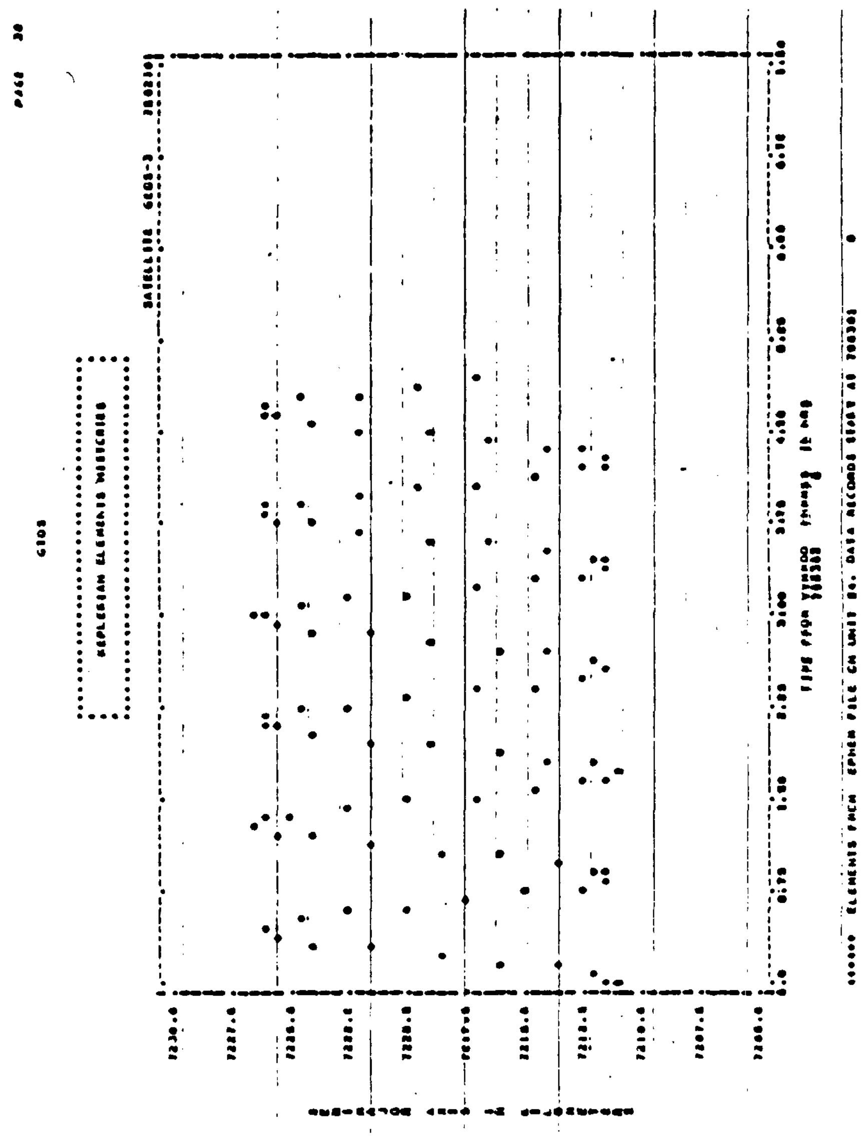


Figure H-11. Plot of Semimajor Axis (in Kilometers Over a Time Period)

H.2.6 EPHEMERIS FILE OUTPUT VECTOR QUALITY REPORT

Figure H-12 is an example of the Ephemeris File Output Vector Quality Report. This report lists each requested ephemeris point.

H.3 DIFFERENTIAL CORRECTION (DC) PROGRAM OUTPUT

The nine reports available for any GTDS Differential Correction Program run are as follows:

- Initial Conditions Report
- Observation Residual Report
- Differential Correction Integration Statistics Report
- Differential Correction Elements Report
- Convergence Parameter Report
- Variance-Covariance Matrix Report
- End-of-Iteration Report
- Differential Correction Final Elements Report
- Orbital Elements Report

At the end of each iteration, five reports are generated based on the DC print-control switch (see keyword PRINTOUT in Section 4): (1) the Observation Residual Report, (2) the Differential Correction Elements Report, (3) the Convergence Report, (4) the Variance-Covariance Matrix Report, and (5) the End-of-Iteration Report.

At the end of the DC Program run, the Differential Correction Final Elements Report is printed twice (once in the mean-of-1950.0 frame and once in the true-of-date frame) followed by the Orbital Elements Report.

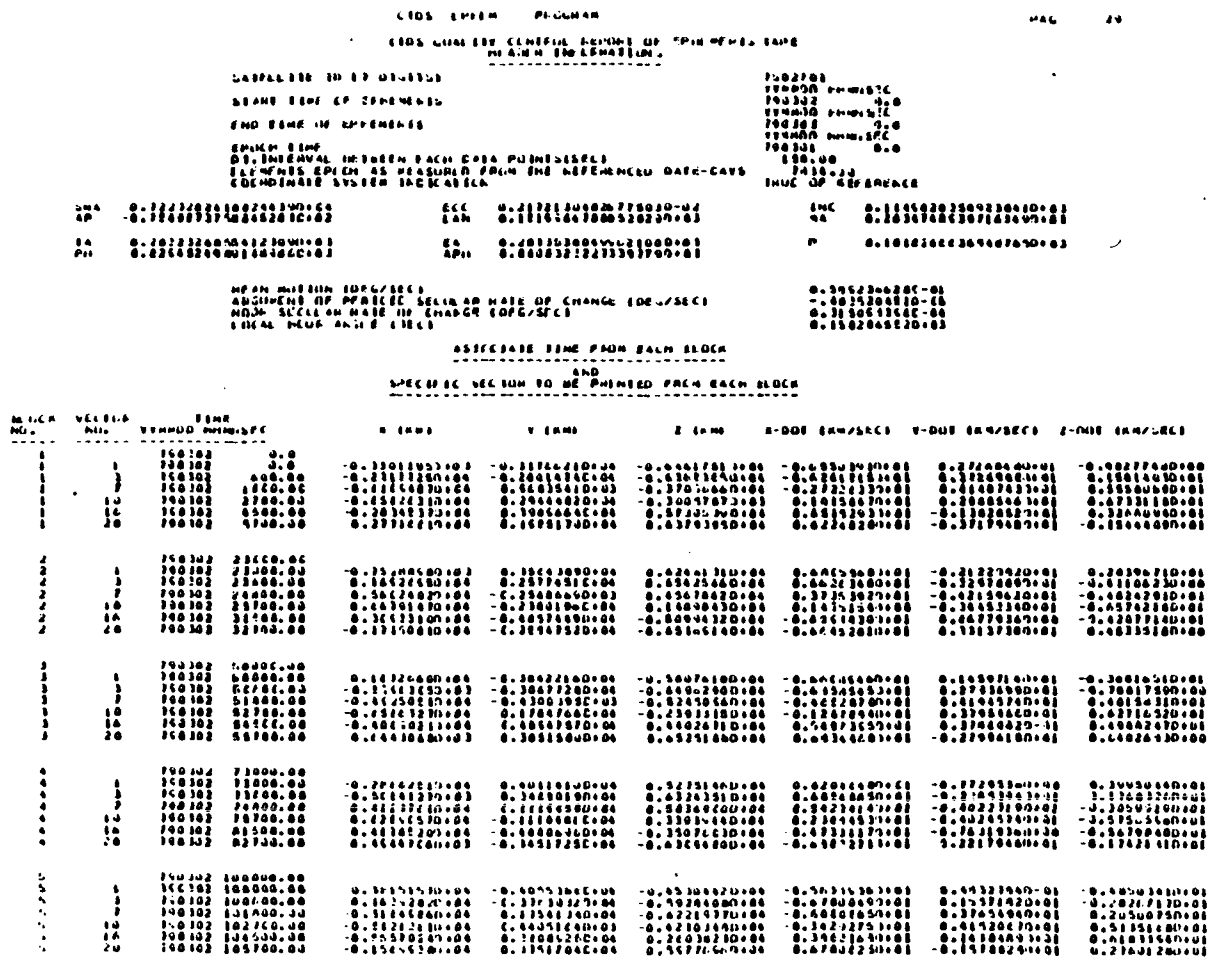


Figure H-12. Ephemeris File Output Vector Quality Report (1 of 2)

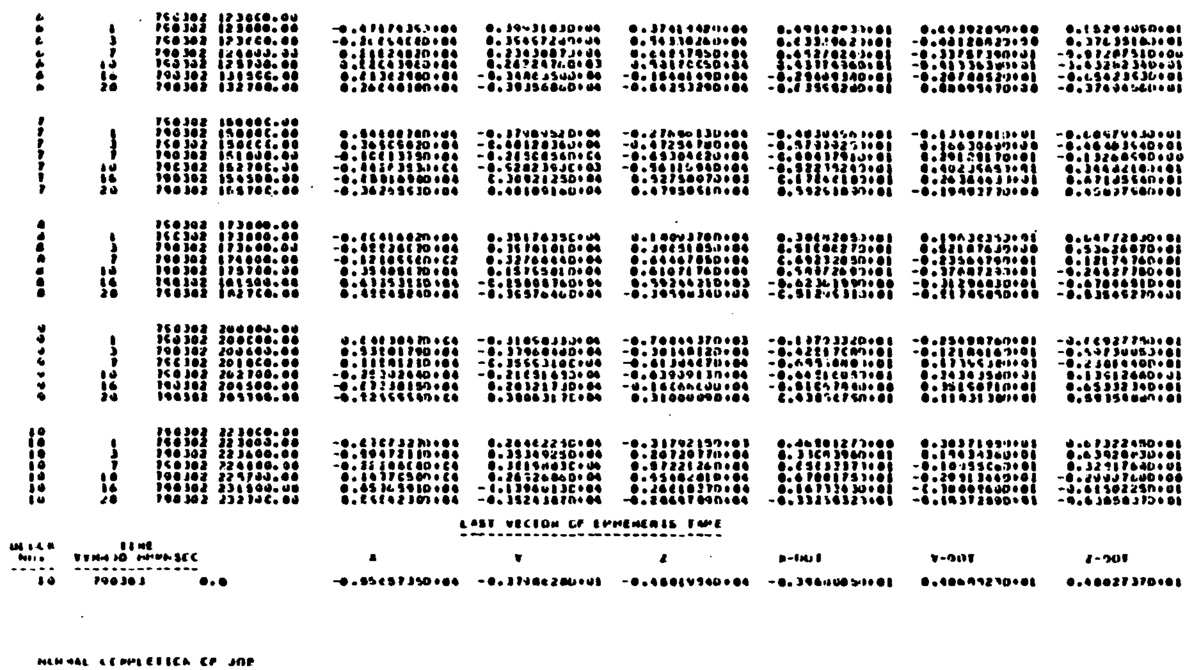


Figure H-12. Ephemeris File Output Vector Quality Report (2 of 2)

In addition to these nine reports, the user may request printer plots of the observation residuals. These plots, which are not shown, are generated via keyword cards PRINTOUT and Station Card 3. For details, see descriptions in Section 4.

If Statistical Output Reports (SORs) are requested, they will appear after the Differential Correction reports. The four reports are

- Category Summary Report
- Batch Detail Report
- Recap of Batched O-C Summaries
- GTDS Tracker-Oriented O-C Summaries

A fifth report, TDRSS Ground Transponder Summary Calibration Statistics Report, appears if TDRS ground transponder range data are present. These reports may be generated for the first and last DC iterations or for either the first DC iteration only or the last DC iteration only.

H.3.1 INITIAL CONDITIONS REPORT

This report (see Figure H-13) is very similar to the Initial Conditions Report of the Ephemeris Generation Program. It contains nearly all of the information discussed in Section H.2.1 plus some information unique to the differential correction process. A report will be generated for each satellite included in a multisatellite run (e.g., TDRSS processing).

There is a section of output shown in Figure H-13 that lists, for each unknown, the name of the parameter, the a priori value, and the standard deviation. This section also specifies the total number of unknowns and the number of dynamic and nondynamic parameters. Immediately following is another

```
GTDRS PH. 3 N-D-2U-GAP, 1U-D-SST (SQA ONLY) SOLVE FOR TDRS 1 AND SOL9-NC
                    GTDS INITIAL CONDITIONS REPORT
                                INDEX - GTDS INITIAL CONDITIONS REPORT
                                DIFFERENTIAL CORRECTION
          GTDRS PH. 3 N-D-2U-GAP, 1U-D-SST (SQA ONLY) SOLVE FOR TDRS 1 AND SOL9-NC

CURRENT TIME OCT 24, 1985,  1 HRS,23 MIN,  27.349 SEC                          SCOPES NOT  IN USE
LEVEL OF OUTPUT IS  8

SATELLITE NAME          GEOS-3
SATELLITE NUMBER        7502701
SATELLITE CONFIGURATION:
     SATELLITE IS SPHERICAL
     DIAMETER                 =  0.13381163D+01  METERS    COEFFICIENT OF DRAG USED FOR THE RUN =  0.20000000D+01
     MASS                     =  0.33656000D+03  KG
     AERO VARIATION (AMOD)    =  0.0
     REFLECTIVITY CONSTANT    =  0.12000000D+01            AREA FOR RADIATION PRESSURE          =  0.14000000D+01 M**2

SATELLITE NAME          TDRS-1
SATELLITE NUMBER        7000101
SATELLITE CONFIGURATION:
     SATELLITE IS SPHERICAL
     DIAMETER                 =  0.71364965D+01  METERS    COEFFICIENT OF DRAG USED FOR THE RUN =  0.20000000D+01
     MASS                     =  0.21332000D+04  KG
     AERO VARIATION (AMOD)    =  0.0
     REFLECTIVITY CONSTANT    =  0.15610000D+01            AREA FOR RADIATION PRESSURE          =  0.40000000D+02 M**2

SATELLITE NAME          TDRS 3
SATELLITE NUMBER        7590301
SATELLITE CONFIGURATION:
     SATELLITE IS SPHERICAL
     DIAMETER                 =  0.71364965D+01  METERS    COEFFICIENT OF DRAG USED FOR THE RUN =  0.20000000D+01
     MASS                     =  0.21332000D+04  KG
     AERO VARIATION (AMOD)    =  0.0
     REFLECTIVITY CONSTANT    =  0.12000000D+01            AREA FOR RADIATION PRESSURE          =  0.40000000D+02 M**2

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * * *ORBIT GENERATOR OPTIONS* * * * * * * * * * * * * * * * * *

OPTIONS FOR GEOS-3

ORBIT GENERATOR TYPE-
NUMERICAL INTEGRATION OF COWELL EQUATIONS OF MOTION

* * * * * * * * * * * * * * * * * * * * * * * * * NO PARTIALS BEING COMPUTED* * * * * * * * * * * * * * * * * * * * * *

OPTIONS FOR TDRS 1

ORBIT GENERATOR TYPE-
NUMERICAL INTEGRATION OF COWELL EQUATIONS OF MOTION

STATE PARTIALS TYPE-
CARTESIAN USING NUMERICAL INTEGRATION
                                      2 X 2 BY  0 GRAVITY FIELD USED IN COMPUTATION OF PARTIALS

NON-STATE PARTIALS (COMPUTED BY NUMERICAL INTEGRATION)-
                                                        RADIATION PARTIALS

OPTIONS FOR TDRS 3

ORBIT GENERATOR TYPE-
NUMERICAL INTEGRATION OF COWELL EQUATIONS OF MOTION
       NO STATE PARTIALS CONSIDERED

NON-STATE PARTIALS (COMPUTED BY NUMERICAL INTEGRATION)-
                                                        NO NON-STATE PARTIALS CONSIDERED
```

Figure H-13. DC Initial Conditions Report (1 of 10)

```
GTDS PH. 3 H-D-2B-GRP, [illegible] SOLVE FOR TDRS 1 AND SOLR-RC
GTDS INITIAL CONDITIONS REPORT

*****************************************************************
                  TRAJECTORY INITIAL CONDITIONS
                  (AS SPECIFIED BY INPUT DATA)
                      CASE NUMBER        1
EPOCH TIME GEOS-3             *MAR  1, [illegible], 12 HRS, 0 MIN, 0.0 SEC
EPOCH TIME TDRS 1             *MAR  1, [illegible], 12 HRS, 0 MIN, 0.0 SEC
EPOCH TIME TDRS 2             *MAR  1, [illegible], 18 HRS, 0 MIN, 0.0 SEC
REFERENCE DATE OF INPUT       *MAR  1, [illegible]
OBSERVATION START TIME        *FEB 28, [illegible],  0 HRS, 0 MIN, 0.0 SEC
OBSERVATION STOP TIME         *MAR  3, [illegible],  0 HRS, 0 MIN, 0.0 SEC
OBSERVATION INPUT SOURCE      *GCM TAPE
```

Figure H-13. DC Initial Conditions Report (2 of 10)

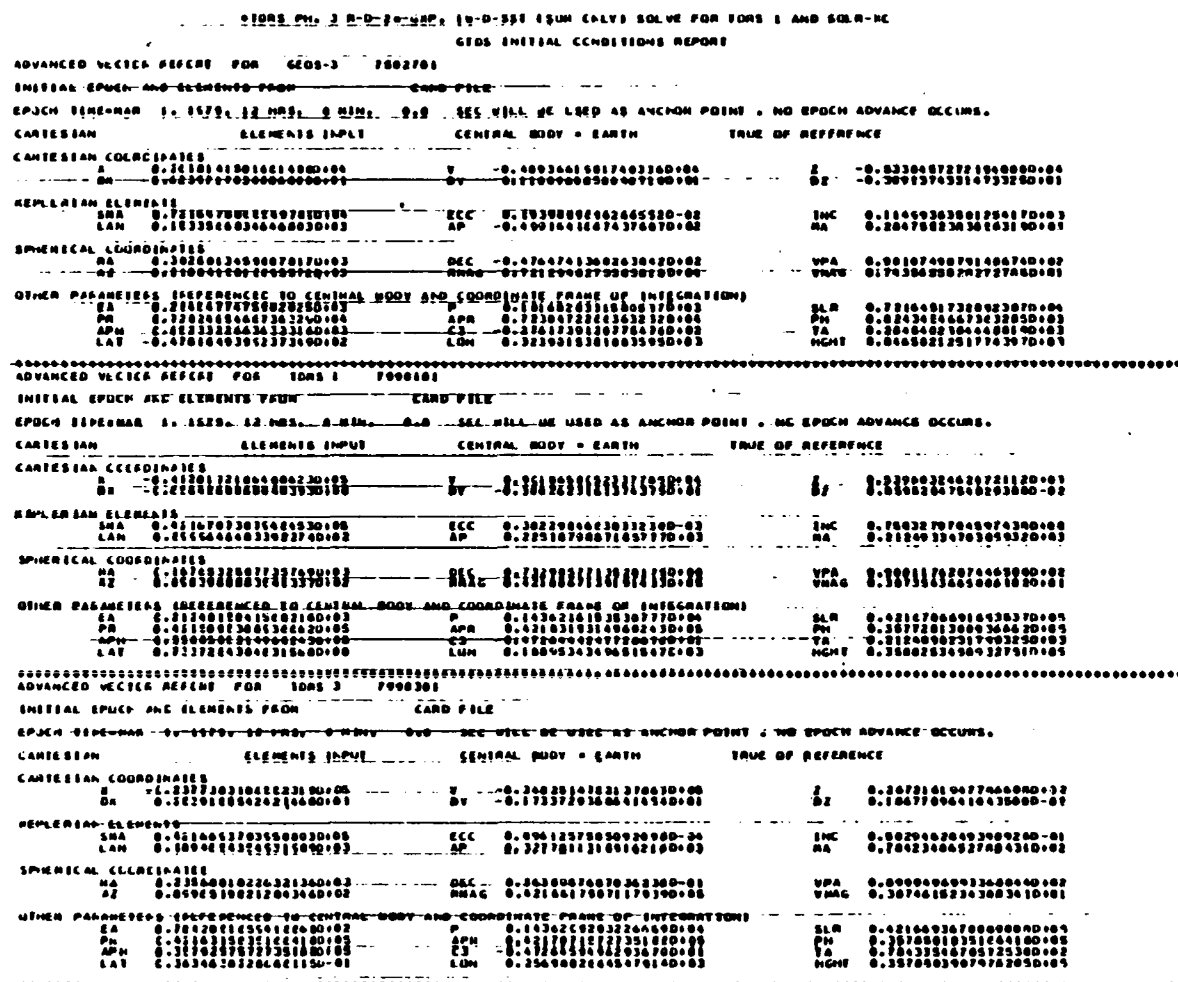


Figure H-13. DC Initial Conditions Report (3 of 10)

```
GTDS PH. 3 H-D-20-GAP, 1H-D-SST (SUR ONLY) SOLVE FOR TDRS 1 AND SOLR-RC
                 GTDS INITIAL CONDITIONS REPORT

                              DEFINITIONS OF ABBREVIATIONS

X,Y,Z      = POSITION IN KM                                  EA     = ECCENTRIC ANOMALY IN DEGREES
DX,DY,DZ   = VELOCITY IN KM/SEC                              P      = PERIOD IN MINUTES
SMA        = SEMI-MAJOR AXIS IN KM                           SLR    = SEMI-LATUS RECTUM IN KM
ECC        = ECCENTRICITY                                    PR     = PERIFOCAL RADIUS IN KM
INC        = INCLINATION IN DEGREES                          APR    = APOFOCAL RADIUS IN KM
RASN       = RIGHT ASCENSION OF ASCENDING NODE DEGREES       PH     = MEAN PERIFOCAL HEIGHT IN KM
AP         = ARGUMENT OF PERIFOCUS IN DEGREES                APH    = MEAN APOFOCAL HEIGHT IN KM
MA         = MEAN ANOMALY IN DEGREES                         C3     = ENERGY IN KM**2/SEC**2
RA         = RIGHT ASCENSION IN DEGREES                      TA     = TRUE ANOMALY IN DEGREES
DEC        = DECLINATION IN DEGREES                          LAT    = LATITUDE IN DEGREES
VPA        = VERTICAL FLIGHT PATH ANGLE IN DEG               LON    = LONGITUDE IN DEGREES
AZ         = VELOCITY AZIMUTH IN DEGREES                     HGHT   = HEIGHT IN KM
RMAG       = MAGNITUDE OF POSITION VECTOR IN KM
VMAG       = MAGNITUDE OF VELOCITY VECTOR IN KM
```

Figure H-13. DC Initial Conditions Report (4 of 10)

```
GTCRS PH. 3 R-D-2B-GRP, 1B-D-SST (SOR ONLY) SOLVE FOR TONS 1 AND SOLR-RC
                    GTDS INITIAL CONDITIONS REPORT

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * NUMERICAL INTEGRATION OPTIONS AND PARAMETERS * * * * * * * * * * * * * * * * * * * * * *

NUMERICAL INTEGRATION TYPE FOR STATE PROPAGATION
    12 TH ORDER SUMMED COWELL/ADAMS PREDICT-PARTIAL CORRECT

* * * * * * * * * * * * * * * * * * * * * * * INTEGRATION PARAMETERS * * * * * * * * * * * * * * * * * * * * * * * *
        CONVERGENCE TOLERANCE FOR PREDICTOR-CORRECTOR ITERATIONS             =   0.50000D+00
        MAXIMUM NUMBER OF CORRECTOR ITERATIONS                               =      3
        CORRECTOR TOLERANCE FOR EQUATIONS OF MOTIONS MULTISTEP STARTER       =   0.10000D-12
        CORRECTOR TOLERANCE FOR VARIATIONAL EQUATIONS STARTER                =   0.10000D-12
        MAXIMUM NUMBER OF CORRECTOR ITERATIONS IN STARTER                    =     15

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * SECTIONING DEPENDENT PARAMETERS * * * * * * * * * * * * * * * * * * * * * * * *

                              TOTAL NUMBER OF SECTIONS    1    FOR TARGET ONLY

                              FORCE OPTIONS CONSIDERED

      SYSTEM OF INTEGRATION                              TRUE OF REFERENCE
      NAME OF ATMOSPHERIC DENSITY MODEL                  NOT REQUIRED
      NAME OF EARTH POTENTIAL FIELD MODEL                      GEMV 2111 (DEFAULT)
      NAME OF LUNAR POTENTIAL FIELD MODEL                NOT REQUIRED
      NO SECTION MODEL RETRIEVED FROM PERM FILES(DEFAULT AND CARD INPUT USED)

INTEGRATION INFORMATION FOR SEQ-0

                 SECTION  1
INTEG STP MODE       FIXED
STEP SIZE (SEC)       90.0
HARMONICS          ZON-TESL
   MAX DEGREE          8
   MAX ORDER           8
RESONANT POTENTIAL   NO
      ORDER            1
CENTRAL BODY        EARTH
NON-CENT BODY1      MOON
NON-CENT BODY2      SUN
2-BODY METRIC        NO
SOL RAD PRESS        NO
DRAG                 NO
POLAR MOTION         NO
THRUST               NO
INTEG RESTART     MUL-STEP

 ORBIT TYPE        =    COWELL

INTEGRATION INFORMATION FOR TDRS 1

                 SECTION  1
INTEG STP MODE       FIXED
STEP SIZE (SEC)      600.0
HARMONICS          ZON-TESL
   MAX DEGREE          4
   MAX ORDER           4
RESONANT POTENTIAL   NO
      ORDER            1
CENTRAL BODY        EARTH
NON-CENT BODY1      MOON
NON-CENT BODY2      SUN
2-BODY METRIC        NO
SOL RAD PRESS       YES
DRAG                 NO
POLAR MOTION         NO
THRUST               NO
INTEG RESTART     MUL-STEP

 ORBIT TYPE        =    COWELL
```

Figure H-13. DC Initial Conditions Report (5 of 10)

```
ODONS PH. 3 [illegible] SOLVE FOR TDRS 1 AND [illegible]
                    GEOS INITIAL CONDITIONS REPORT

INTEGRATION INFORMATION FOR TDRS 3

                     SECTION 1
INTEG STP MODE        FIXED
STEP SIZE (SEC)       600.0
HARMONICS          ZON-TESL
    MAX DEGREE          4
    MAX ORDER           4
RESONANT POTENTIAL NO
        ORDER           4
CENTRAL BODY        EARTH
NON-CENT BODY1       MOON
NON-CENT BODY2       SUN
2-BODY MOTION        NO
SOL RAD PRESS        NO
DRAG                 NO
POLAR MOTION         NO
THRUST               NO
INTEG RESTART     ALL-STEP

 ORBIT TYPE        =   COWELL

              CROSSOVER CONDITIONS BY SECTION FOR THE TARGET SATELLITE

     MORE THAN ONE CONDITION MAY BE LISTED,ANY ONE OF WHICH MAY CAUSE SECTIONING.  THE FIRST CONDITION TO BE
     SATISFIED [illegible] CROSSOVER CONDITION BETWEEN ANY TWO ADJACENT SECTIONS.  WHEN THE VEHICLE IMPACTS UPON
     THE CENTRAL BODY OR WHEN THE END OF PRINT ARC ( 700301. 163400.000 ) IS REACHED, RUN WILL TERMINATE.

  FROM SECTION  1 TO TERMINATION

     1) SECTIONING DUE TO TIME FROM EPOCH..... 0.12[illegible]D+06 SECONDS

            START AND END TIMES OF THE ORBIT FILES FOR THE TARGET AND RELAY SATELLITES

     SATELLITE                  START TIME                       END TIME
                          (YYMMDD)     (HHMMSS.SSSS)      (YYMMDD)      (HHMMSS.SSSS)
     GEOS-3               700301.       151550.000        700301.        163400.000
     TDRS 1               700228.       210400.030        700302.         30430.000
     TDRS 3               700228.       100700.000        700301.        163300.000

* * * * * * * * * * * * * * * * * * * * * * * * MANEUVERS DATA * * * * * * * * * * * * * * * * * * * * * * * *
                                               0 MANEUVERS THIS FLIGHT

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * * PHYSICAL CONSTANTS * * * * * * * * * * * * * * * * * * * * * *

                    UNIVERSAL GRAVITATIONAL CONSTANT   =   0.667300000D-22 KM**3/(SEC**2)(GRAM)
                    ASTRONOMICAL UNIT                  =   0.149597870D+09 KM
                    SOLAR RADIATION PRESSURE           =   0.456000000D-08 (KG/SEC**2)/KM

     CONSTANTS OF BODIES CONSIDERED THIS FLIGHT
GRAV CONST(KM**3/SEC**2)    EARTH   0.398600440D+06     MOON    0.490277990D+04     SUN   0.132712440D+12
MEAN EQUATORIAL RADIUS(KM)  EARTH   0.637814000D+04     MOON    0.173800000D+04     SUN   0.696000000D+06
ROTATION RATE(RAD/SEC)      EARTH   0.729211550D-04     MOON    0.266169950D-05     SUN   0.0
SPHERE OF INFLUENCE(KM)     EARTH   0.925300000D+06     MOON    0.660000000D+05     SUN   0.0
INVERSE FLATTENING COEFF    EARTH   0.298250000D+03     MOON    0.100000000D+31     SUN   0.100000000D+31
GREENWICH HOUR ANGLE        EARTH   0.591142700D+01
```

Figure H-13. DC Initial Conditions Report (6 of 10)

GTDS PH. 3 R-D-26-GEP; [illegible] (SUR ONLY) SOLVE FOR TDNS 1 AND SOLR-KC

GTDS INITIAL CONDITIONS REPORT

HARMONIC COEFFICIENTS — EARTH

MAXIMUM DEGREE = [illegible]
MAXIMUM ORDER = [illegible]

ZONALS

INDEX N M	VALUE	INDEX N M	VALUE	INDEX N M	VALUE	INDEX N M	VALUE
2 0	-.1082627[illegible]D-02	3 0	0.2535[illegible]D-05	4 0	0.1624[illegible]D-05	5 0	0.2269[illegible]D-06
6 0	[illegible]D-06	7 0	0.3613[illegible]D-06	8 0	0.2100[illegible]D-06		

SECTORALS AND TESSERALS

INDEX N M	VALUE C	VALUE S	INDEX N M	VALUE C	VALUE S
2 1	[illegible]	[illegible]	2 2	0.1571[illegible]D-05	-.9023[illegible]
3 1	0.2[illegible]	0.2[illegible]	3 2	0.3[illegible]D-06	-.2[illegible]
[illegible]	[illegible]	[illegible]	4 1	-.5055[illegible]D-06	-.4[illegible]D-06
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	8 7	0.3[illegible]D-12	0.3[illegible]D-12
8 8	[illegible]D-12	[illegible]D-12			

SUR OPTIONS

SUR IS GENERATED AT FIRST AND LAST DC ITERATION

BATCH CALIBRATION STATISTICS COMPUTED

NO SOR DATA SUBSET GENERATED

NO PUNCHED OUTPUT GENERATED

DETAILED NOISE CRITERIA

STATIONS	GTDS TYPES	MODE	RATE	TECHNIQUE	MAX EDIT LOOP	MAX ORDER	ORDER-CONV CRIT	SIGMA EDIT LOOP
ALL	ALL	ALL	ALL	VDNA	3	[illegible]	0.1	3.0

MINIMUM PERCENTAGE OF DIFFERENCES REQUIRED = 75

Figure H-13. DC Initial Conditions Report (7 of 10)

```
GTDS PH. 3 5-D-2D-GAP, 16-D-LST (SUN CALT) SOLVE FOR TDRS 1 AND SOLR-RC
                    GEOS INITIAL CONDITIONS REPORT

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
                              OUTPUT OPTIONS
GROUND TRACE
      NO

FREQUENCY OF OBSERVATION RESIDUALS REPORT--  TO THE PRINTER.........EVERY 0 ITERATIONS
                                             TO THE SCOPE...........EVERY 1 ITERATIONS

OUTPUT DATA SETS REQUESTED

      EPHEM TAPE OUTPUT NOT REQUESTED
      EDUL  TAPE OUTPUT NOT REQUESTED
      OUTPUT DISK ORBIT FILE NOT REQUESTED      FOR GEOS-3
      OUTPUT DISK ORBIT FILE NOT REQUESTED      FOR TDRS 1
      OUTPUT DISK ORBIT FILE NOT REQUESTED      FOR TDRS 3

PERMANENT FILE REPORT REQUESTED
      NONE AT THIS TIME

WORKING FILE REPORT REQUESTED
      EARTH POTENTIAL
*********************************************************************
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
            EPOCH TIME GEOS-3      MAR  1, 1979, 12 HRS,  0 MIN,  0.0  SEC
            EPOCH TIME TDRS 1      MAR  1, 1979, 12 HRS,  0 MIN,  0.0  SEC
            EPOCH TIME TDRS 3      MAR  1, 1979, 12 HRS,  0 MIN,  0.0  SEC
                   INITIAL CONDITIONS SOLVE PARAMETERS

                       CONSIDER OPTION IS OFF

                   7 TOTAL PARAMETERS TO BE SOLVED
                        0  DYNAMIC PARAMETERS
                        0  STATION LOCATIONS
                        0  ATTITUDE PARAMETERS
                        6  RELAY SATELLITE STATE PARAMETERS
                        1  RELAY SOLAR REFLECTIVITY
                        0  POSSIBLE BIASES
                        0  TRANSPONDER DELAYS
                                                                   APRIORI
PARAMETER TYPE          PARAMETER NAME        APRIORI VALUE        STANDARD DEVIATIONS

STATE (CART.)  1              X   TDRS 1      -0.41201721000D+05   0.10000000000D+71
                              Y   TDRS 1       0.98186500620D+04   0.10000000000D+71
                              Z.  TDRS 1       0.53066324620D+03   0.10000000000D+71
                              DX  TDRS 1      -0.65406400600D+00   0.10000000000D+71
                              DY  TDRS 1      -0.30026231610D+01   0.10000000000D+71
                              DZ  TDRS 1       0.65052047540D-03   0.10000000000D+71
SOLAR RADIATION           SOLRAD  TDRS 1       0.15018067550D+01   0.10000000000D+71
               DIFFERENTIAL CORRECTION CONVERGENCE PARAMETERS

D.C. CONVERGENCE TOLERANCE                         = 0.500000-02
MINIMUM RMS FOR CONVERGENCE TEST                   = 0.300000-05
MAXIMUM NUMBER OF D.C. ITERATIONS                  = 8
MAXIMUM NUMBER OF CONSECUTIVE DIVERGENT ITERATIONS = 4
*********************************************************************
                       OBSERVATION EDIT CRITERIA

OBSERVATION TIME SPAN - START TIME   FEB 28, 1979,  0 HRS,  0 MIN,  0.0  SEC
                        END TIME     MAR  3, 1979,  0 HRS,  0 MIN,  0.0  SEC
IGNORE EDIT CRITERIA     NO
```

Figure H-13. DC Initial Conditions Report (8 of 10)

```
OTCHS PH. 3 R-U-2W-GAP, 1W-D-SST (SUN ONLY) SOLVE FOR TDRS 1 AND SOLR-XC
                    GTDS INITIAL CONDITIONS REPORT

                 DYNAMIC OBSERVATION EDIT/SELECT CRITERIA

     MINIMUM ELEVATION ANGLE        TRACKING SYSTEM      DEGREES
                                       USB-30           =-89.000
                                       USB-85           =-89.000
                                       SRE              =-89.000
                                       ALL OTHERS       =  0.0
     ATMOSPHERIC EDIT VES
     MINIMUM RAY PATH HEIGHT (KM)                       =   10.0
     MAXIMUM CENTRAL ANGLE (DEG)                        = 180.000
     SIGMA MULTIPLIER                                   = 10.000
     RMS ADDER                                          =0.0
     INITIAL RMS                                        =0.10000D+10

                    DETAILED ACCEPT/REJECT CRITERIA

OBSERVATION TIME SPAN      STATIONS    SAT.NO. E-EPOCH   GTDS TYPES      MODE  RATE  EDIT CHKG.

ACCEPT 1
790301 100000. - 790301 100000.  (ALL)  (ALL)  (ALL)  SVR  URAN URAN  (ALL) (ALL) EVERY  ONE
790301 100000. - 790301 100000.  (ALL)  (ALL)  (ALL)  SVRR URDP URDP  (ALL) (ALL) EVERY  ONE
790301 100000. - 750301 100000.  (ALL)  (ALL)  (ALL)       TD2G       (ALL) (ALL) EVERY  ONE
790301 100000. - 790301 100000.  (ALL)  (ALL)  (ALL)       TR2G       (ALL) (ALL) EVERY  ONE
790301 100000. - 750301 100000.  (ALL)  (ALL)  (ALL)       TDMG       (ALL) (ALL) EVERY  2 ND
790301 100000. - 790301 100000.  (ALL)  (ALL)  (ALL)       TRMG       (ALL) (ALL) EVERY  2 ND
***********************************************************************************************
                    WEIGHT MATRIX COMPUTATION DATA
   RANGE, ELEVATION ANGLE, RANGE RATE                  = 0.0
   AZIMUTH                                             = 0.10000000D+01
 WEIGHT FACTOR CONSTANT OFFSET
   RANGE, ELEVATION ANGLE, RANGE RATE                  = 0.10000000D+01
   AZIMUTH                                             = 0.0
 SCALING CONSTANTS USED TO COMPUTE OBSERVATION WEIGHT
   OBSERVATION NOISE SCALING FACTOR                    = 0.10000000D+01
   A PRIORI OBSERVATION UNCERTAINTY SCALING FACTOR     = 0.0

                    MEASUREMENT STANDARD DEVIATIONS
       MEASUREMENT TYPE             SIGMA VALUE                 SIGMA UNITS

          URAN SRE                    30.0000                   METERS
          URDP SRE                    10.0000                   CM/SEC
          TR2G TDRS                   10.0000                   METERS
          TC10 TDRS                    0.0030                   HRTZ
          TC2G TDRS                    0.0200                   HRTZ
          TRMG TDRS                   10.0000                   METERS
          TDMG TDRS                    0.0030                   HRTZ
          TD2G TDRS                    0.0050                   HRTZ
          TD1S TDRS                  200.0000                   HRTZ
          TDMG TDRS                    0.0050                   HRTZ
***********************************************************************************************
```

Figure H-13. DC Initial Conditions Report (9 of 10)

[illegible] PH. 3 [illegible] SOLVE FOR TDRS 1 AND [illegible]

GTDS INITIAL CONDITIONS REPORT

OBSERVATION CORRECTION OPTIONS

STATION NAME	PCVS NUMBER	LIGHT TIME	REFRACTION IONOSPHERE	REFRACTION TROPOSPHERE	ANTENNA MOUNT	TRANSPONDER DELAY
[illegible]		NO	NO	NO	NO	NO
[illegible]		NO	NO	NO	NO	NO
[illegible]		NO	NO	NO	NO	NO
[illegible]		NO	NO	NO	NO	NO
[illegible]		NO	NO	NO	NO	NO

FIRST ITERATION AT WHICH CORRECTIONS ARE APPLIED = ITERATION 1
FREQUENCY AT WHICH CORRECTIONS ARE TO BE UPDATED = EVERY 0 ITERATION
MINIMUM ELEVATION ANGLE USED FOR REFRACTION CORRECTIONS = 0.0 DEGREES

END OF GTDS INITIAL CONDITIONS REPORT

Figure H-13. DC Initial Conditions Report (10 of 10)

section of the report that contains the convergence criteria and the maximum number of consecutive divergent iterations permitted. The specified observation edit criteria and observation weights are also included in Figure H-13. The final section of information in Figure H-13 contains the observation correction options specified for each of the stations pertinent to this run.

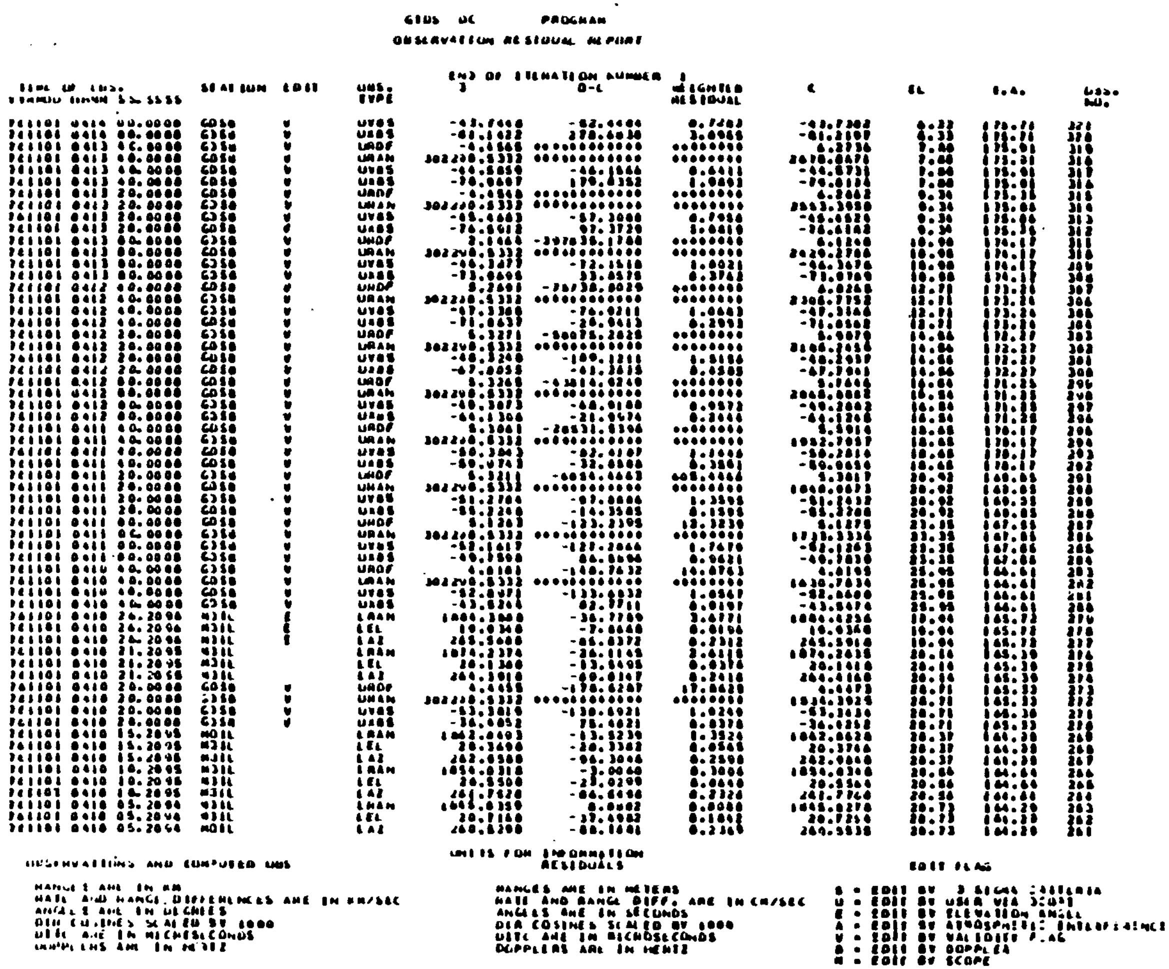
Not shown in Figure H-13 are the file reports which are optionally generated by the Data Management (Section H.9). By default, the reports of Figure H-13 are followed by the Solar/Lunar/Planetary (SLP) Ephemeris Summary Report (Figure H-52) and the Station Geodetics Working File Report (Figure H-47).

H.3.2 OBSERVATION RESIDUAL REPORT

Figure H-14 is an example of the Observation Residual Report. By default, it is generated during every DC Program iteration. However, this frequency may be modified by the user via the options on the PRINTOUT keyword card.

The following information is contained in this report:

- Greenwich mean time of the observation--This time is the station-receive time and does not reflect any light time corrections, even if the user has specified that they are to be made.
- Station name, edit flag, and observation type--An explanation of the various edit flags appears at the bottom of each page of printout.
- The observation, residual, ratio to sigma, computed value, elevation angle, true anomaly, and observation number--Any corrections (such as refraction


GIDS DC PROGRAM
OBSERVATION RESIDUAL REPORT

END OF ITERATION NUMBER 1

TIME OF OBS. YYMMDD HHMM SS.SSSS | STATION | EDIT | OBS. TYPE | 3 | O-C | WEIGHTED RESIDUAL | C | EL | E.A. | OBS. NO.

OBSERVATIONS AND COMPUTED OBS
RANGES ARE IN KM
RATE AND RANGE DIFFERENCES ARE IN KM/SEC
ANGLES ARE IN DEGREES
DIR COSINES SCALED BY 1000
DTEC ARE IN MICROSECONDS
DOPPLERS ARE IN HERTZ

UNITS FOR INFORMATION RESIDUALS
RANGES ARE IN METERS
RATE AND RANGE DIFF. ARE IN CM/SEC
ANGLES ARE IN SECONDS
DIR COSINES SCALED BY 1000
DTEC ARE IN MICROSECONDS
DOPPLERS ARE IN HERTZ

EDIT FLAG
S = EDIT BY 3 SIGMA CRITERIA
U = EDIT BY USER VIA SCOPE
E = EDIT BY ELEVATION ANGLE
A = EDIT BY ATMOSPHERIC INTERFERENCE
V = EDIT BY VALIDITY FLAG
D = EDIT BY DOPPLER
R = EDIT BY SCOPE

Figure H-14. Observation Residual Report (for Single Satellite Runs) (1 of 2)

GTDHS PH. J H-O-SU-GHP, SS-U-SSF (SOF ONLY) SOLVE FOR TDRS 1 AND SOLR-RC PAGE 12

OBSERVATION RESIDUAL REPORT

END OF ITERATION NUMBER 1

TIME OF OBS. YYMMDD HHMM SS.SSSS	STATION	EDIT	OBS. TYPE	O	O-C	WEIGHTED RESIDUAL	C	EL	T.A.	USER	TDRS UP	TDRS DOWN	OBS. NO.

OBSERVATIONS ARE COMPUTED ERS

RANGES ARE IN KM
RATE AND RANGE DIFFERENCES ARE IN KM/SEC
ANGLES ARE IN DEGREES
DIR COSINES SCALED BY 1000
DTIC ARE IN MICROSECONDS
DOPPLERS ARE IN HERTZ

UNITS FOR INFORMATION RESIDUALS

RANGES ARE IN METERS
RATE AND RANGE DIFF. ARE IN CM/SEC
ANGLES ARE IN SECONDS
DIR COSINES SCALED BY 1000
DTIC ARE IN MICROSECONDS
DOPPLERS ARE IN HERTZ

EDIT FLAG

S = EDIT BY 10 SIGMA CRITERIA
U = EDIT BY USER VIA OCCPT
E = EDIT BY ELEVATION ANGLE
A = EDIT BY ATMOSPHERIC INTERFERENCE
V = EDIT BY VALIDITY FLAG
D = EDIT BY DOPPLER
R = EDIT BY SCOPE

Figure H-14. Observation Residual Report (for TDRSS Processing Runs) (2 of 2)

corrections) are applied to the observed value, not to the computed value. The ratio to sigma reflects the ratio of the residual to the specified observation standard deviation.

- Satellite or ground transponder name, forward and return link relay identifiers, and differenced Doppler reference and comparison identifiers for runs in which TDRSS tracking data is processed.

H.3.3 DIFFERENTIAL CORRECTION INTEGRATION STATISTICS REPORT

This report summarizes the integration statistics of a Differential Correction run and appears immediately after the Observation Residual Report. The order of integration is always listed. If applicable, the total number of steps used for the integration span and the total number of steps used for the observation span are reported for each satellite in the run. Figure H-15 gives an example of this report for a run which includes a TDRSS satellite.

H.3.4 DIFFERENTIAL CORRECTION ELEMENTS REPORT

This report contains the solve-for resultant vehicle elements in various coordinate reference systems including Cartesian, Keplerian, spherical, and flight parameter. These elements are output in the coordinate frame in which the integrator is working and also the coordinate frame that was specified on input. Therefore, if the central body or frame of the integrator is not identical to that specified on the input elements, the report will be generated in both frames. Besides the value of the current elements, the report contains the a priori values, previous values, and associated differences. The current standard deviations are also included in the report.

GEOS INTEGRATION STATISTICS REPORT

ORDER OF INTEGRATION USED 12

SATELLITE GEOS-3

TOTAL NUMBER OF STEPS FOR INTEGRATION SPAN 250

TOTAL NUMBER OF STEPS FOR OBS SPAN 250

SATELLITE TDRS 1

TOTAL NUMBER OF STEPS FOR INTEGRATION SPAN 171

TOTAL NUMBER OF STEPS FOR OBS SPAN 171

Figure H-15. DC Integration Statistics Report

A sample of this output is shown in Figure H-16. The output values in this report are always in the inertial frame (the user has no option to output in the body-fixed frame). Even if the central body is other than Earth, no rotations are performed before generating the Keplerian elements and other parameters; therefore, all lunar output is in a selenocentric coordinate system (not selenographic).

H.3.5 DIFFERENTIAL CORRECTION CONVERGENCE REPORT

Figure H-17 is an example of the Differential Correction Convergence Report. The report contains a history of those parameters designated as unknowns for this run. Such information as a priori value, current value standard deviation, current/previous difference, current/a priori difference, and previous value are included for each parameter. A history of the parameter change by iteration is also included. The coordinate frame of this output is always identical to the frame of the integrator. A report will be generated for each
satellite with solve parameters in a multisatellite run (e.g., TDRSS processing).

H.3.6 VARIANCE-COVARIANCE MATRIX REPORT

Figure H-18 is an example of the output of this matrix. Since the variance-covariance matrix is symmetric, only the upper triangular portion (including the diagonal) of the matrix is printed. The lower triangular portion of this printout reflects the correlation coefficients of the specified unknowns.

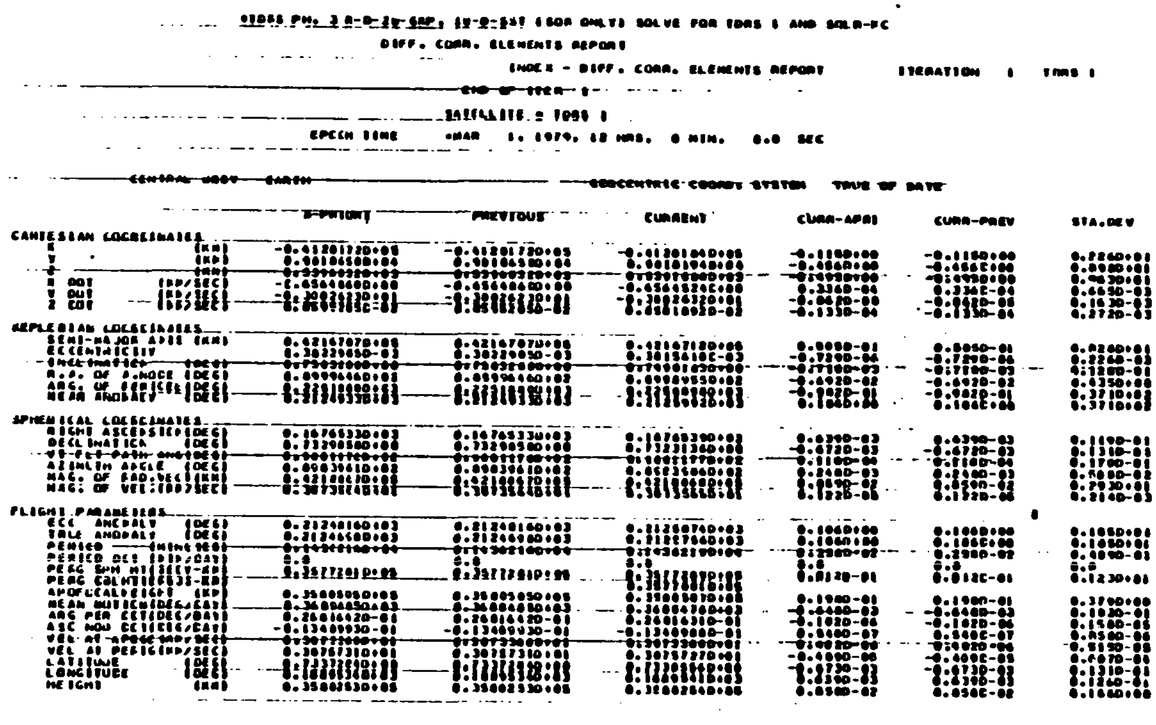


Figure H-16. Differential Correction Elements Report

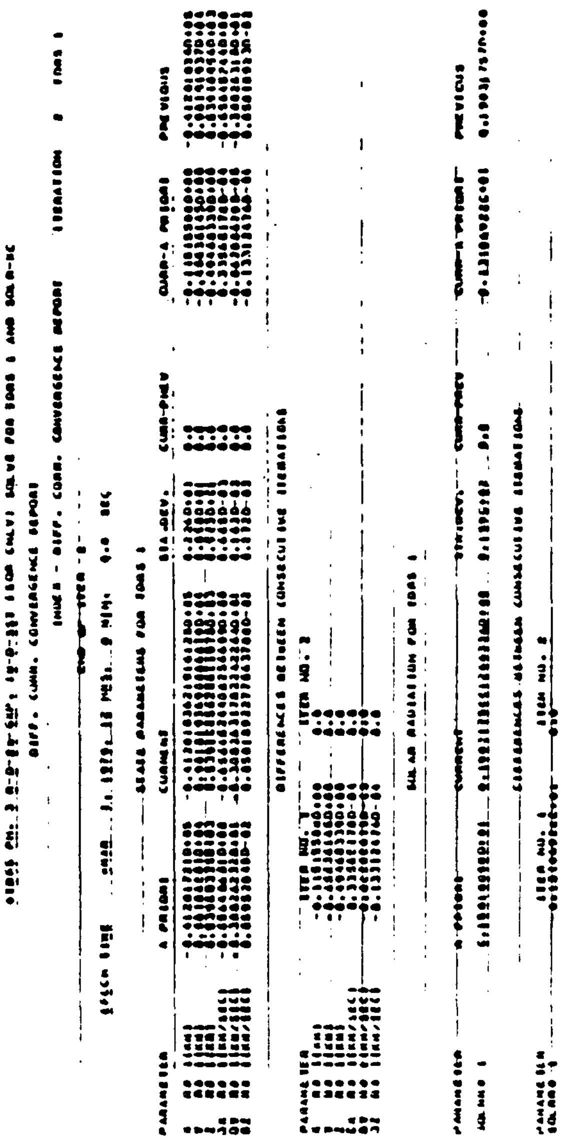


Figure H-17. Differential Convergence Report

VARIANCE-COVARIANCE MATRIX AND ASSOCIATED CORRELATION COEFFICIENTS

UPPER TRIANGLE IS VARIANCE-COVARIANCE MATRIX.
LOWER TRIANGLE ELEMENTS ARE CORRELATION COEFFICIENTS WITH DIAGONAL ELEMENTS (WHICH ARE EQUAL TO ONE) OMITTED.

NTOTAL = 7, NSCLV = 7, NCRTOR = 7

	X KM I	Y KM I	Z KM I	DX KM I	DY KM I	DZ KM I	SOLARG I
X KM I	0.51168170D+01	0.20203460D+02	0.21713220D+02	-0.15027740D-02	0.36902620D-03	0.60005610D-03	0.15673770D+00
Y KM I	0.5458	0.80643100D+02	0.86313820D+02	-0.59731790D-02	0.14688800D-02	0.73870060D-02	0.20200600D+00
Z KM I	0.5000	0.9502	0.92690600D+02	-0.63905180D-02	0.15710420D-02	0.25580910D-02	0.24007170D+01
DX KM I	-0.5555	-1.0000	-0.9900	0.44233830D-06	-0.10860670D-06	-0.17693490D-06	0.19457220D-04
DY KM I	0.6060	0.9996	0.9907	-0.9995	0.86695850D-07	0.43423110D-07	0.74105100D-04
DZ KM I	0.5774	0.9110	0.5166	-0.9779	0.5769	0.74000040D-07	-0.79473180D-04
SOLARG I	0.0044	0.0021	0.0157	C.0010	0.0206	-0.0186	0.25126200D+03

Figure H-18. Variance/Covariance Matrix Report

H.3.7 END-OF-ITERATION REPORT

Figure H-19 is an example of the End-of-Iteration Report. The report is designed to give a compact status report of the differential correction process. The values of current weighted, as well as predicted, previous, and smallest weighted root mean square (rms), are set off in a box near the top of the report. These values determine the status of the run as far as convergence or divergence is concerned. The value associated with the title PENALTY is meaningful only if one is running under control of the Marquardt algorithm. This process is further discussed in Section 3.2.1.7. The rest of the output reflects observation summary statistics.

H.3.8 DIFFERENTIAL CORRECTION FINAL ELEMENTS REPORT

The Differential Correction Final Elements Report (see Figure H-20) is quite similar to the End-of-Iteration Report, except that it contains information pertaining to the final set of elements. This report is generated in both the mean-of-1950.0 system and the true-of-date system. This report is generated for each satellite that has been solved for in a multisatellite run (e.g., TDRSS processing).

H.3.9 ORBITAL ELEMENTS REPORT

The final DC Program report is the Orbital Elements Report shown in Figure H-21. This report includes the Brouwer mean elements for Brouwer integrators and osculating elements for all other integrators by default. The choice of output elements can be modified by the DCFDR keyword card. The elements are referenced true-of-date and are geocentric, selenocentric, heliocentric, or planetocentric if the central body is the Earth, the Moon, the Sun, or a planet, respectively. This report will be generated for each satellite that is solved for in a multisatellite run (e.g., TDRSS processing).

TDRS PH. 3 [illegible] SOLVE FOR TDRS 1 AND SOLR-RC

DIFFERENTIAL CORRECTION END OF ITERATION REPORT

ITERATION NUMBER 2

SATELLITE	GECO-3 . 7502701	CURRENT WEIGHTED RMS	0.25070622D+02	START TIME	790228 191600.000
EPOCH	790361 120000.000	PREDICTED WEIGHTED RMS	0.25070622D+02	END TIME	790302 30030.000
COORD. SYSTEM	TRUE OF DATE	PREVIOUS WEIGHTED RMS	0.25003561D+02	NO. OBS. AVAILABLE	1060
CENTRAL BODY	EARTH	SMALLEST WEIGHTED RMS	0.25003561D+02	NO. OBS. INCLUDED	100
		RELATIVE CHANGE IN RMS	0.15691165D-03	NO. OBS. ACCEPTED	100 100 PCT.
		PERMCTY	.010		
		DC HAS CONVERGED			

OBSERVATION SUMMARY BY TYPE

TYPE	URAN	URDF	TR26	TD26	TD26	TANG	TDNG	TD26	TD1S	TDNG
TOTAL NO.	100	107	179	207	49	30	33	19	79	5
NO. ACCEPTED	35 (20%)	34 (10%)	34 (19%)	29 (14%)	22 (44%)	3 (7%)	0 (0%)	0 (0%)	0 (0%)	3 (60%)
WEIGHTED RMS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.22100D+00	0.0	0.0	0.0	0.43470D+01
MEAN RESIDUAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.22100D+01	0.0	0.0	0.0	0.21040D-01
STANDARD DEV	0.15616D+00	0.45260D-02	0.45175D+01	0.13920D+00	0.40700D-01	0.10460D-01	0.0	0.0	0.0	0.13000D-02

OBSERVATION SUMMARY BY STATION

STATION	[illegible]	[illegible]	[illegible]	[illegible]	CTNJ	ORRJ	UTBJ	UTBJ	CTNJ	MATJ
TYPE	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
TOTAL NO.	3	0	0	0	0	0	0	0	0	0
NO. ACCEPTED	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
WEIGHTED RMS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STANDARD DEV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

STATION	TSTJ	GCSB	GDSB	GDSB	ORR3	ORR3	ORR3	WHSK	WHSK	WHSK
TYPE	ALL	ALL	URAN	URDF	ALL	URAN	URDF	ALL	TR26	TD26
TOTAL NO.	0	185	83	102	178	89	85	294	107	76
NO. ACCEPTED	0 (0%)	0 (0%)	0 (0%)	0 (0%)	69 (39%)	35 (39%)	34 (40%)	0 (0%)	0 (0%)	0 (0%)
WEIGHTED RMS	0.0	0.0	0.0	0.0	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0
STANDARD DEV	0.0	0.0	0.0	0.0	0.0	0.15610D+00	0.45260D-02	0.0	0.0	0.0

STATION	WHSK	WHSK	WHSK	WHSK	WHSK	WHSK	WHSK	WHSK	WHSK	WHSK
TYPE	TD26	TNFG	ALL	TR26	TD26	TD26	TD1S	ALL	TR26	TD26
TOTAL NO.	20	20	201	00	01	19	19	219	00	00
NO. ACCEPTED	0 (0%)	0 (0%)	84 (41%)	40 (45%)	16 (31%)	0 (0%)	0 (0%)	27 (12%)	14 (17%)	13 (16%)
WEIGHTED RMS	0.0	0.0	[illegible]	[illegible]	[illegible]	0.0	0.0	[illegible]	[illegible]	[illegible]
STANDARD DEV	0.0	0.0	[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	0.11050D+00	0.10030D-07

STATION	WHSK
TYPE	TD1S
TOTAL NO.	60
NO. ACCEPTED	0 (0%)
WEIGHTED RMS	0.0
STANDARD DEV	0.0

OBSERVATION SUMMARY BY 20 DEGREE TRUE ANOMALY INTERVAL

INTERVAL	00-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180
TOTAL NO.	106	0	0	132	26	0	16	40	109
NO. ACCEPTED	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	27 (24%)

INTERVAL	180-200	200-220	220-240	240-260	260-280	280-300	300-320	320-340	340-360
TOTAL NO.	6	30	0	74	130	48	90	106	42
NO. ACCEPTED	3 (50%)	30 (100%)	0 (0%)	69 (93%)	47 (36%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

THERE ARE 7 SOLVE PARAMETERS

NUMBER OF DYNAMIC SOLVE = 0

NUMBER OF STATION LOCATIONS BEING SOLVED = 0

NUMBER OF RELAY SATELLITE STATE PARAMETERS BEING SOLVED = 6
A RO 1 E RO 1 I RO 1 RA RO 1 DX RO 1 DY RO 1 CR RO 1

NUMBER OF RELAY SOLAR REFLECTIVITY PARAMETERS BEING SOLVED = 1
SOLRRC 1

NUMBER OF TRANSPONDER DELAYS BEING SOLVED = 0

NUMBER OF BIASES BEING SOLVED = 0

*** FILE GENERATION SUMMARY ***

NO FILES HAVE BEEN GENERATED

NUMBER OF GTDS ERRORS ENCOUNTERED TO DATE = 0

Figure H-19. End-of-Iteration Report

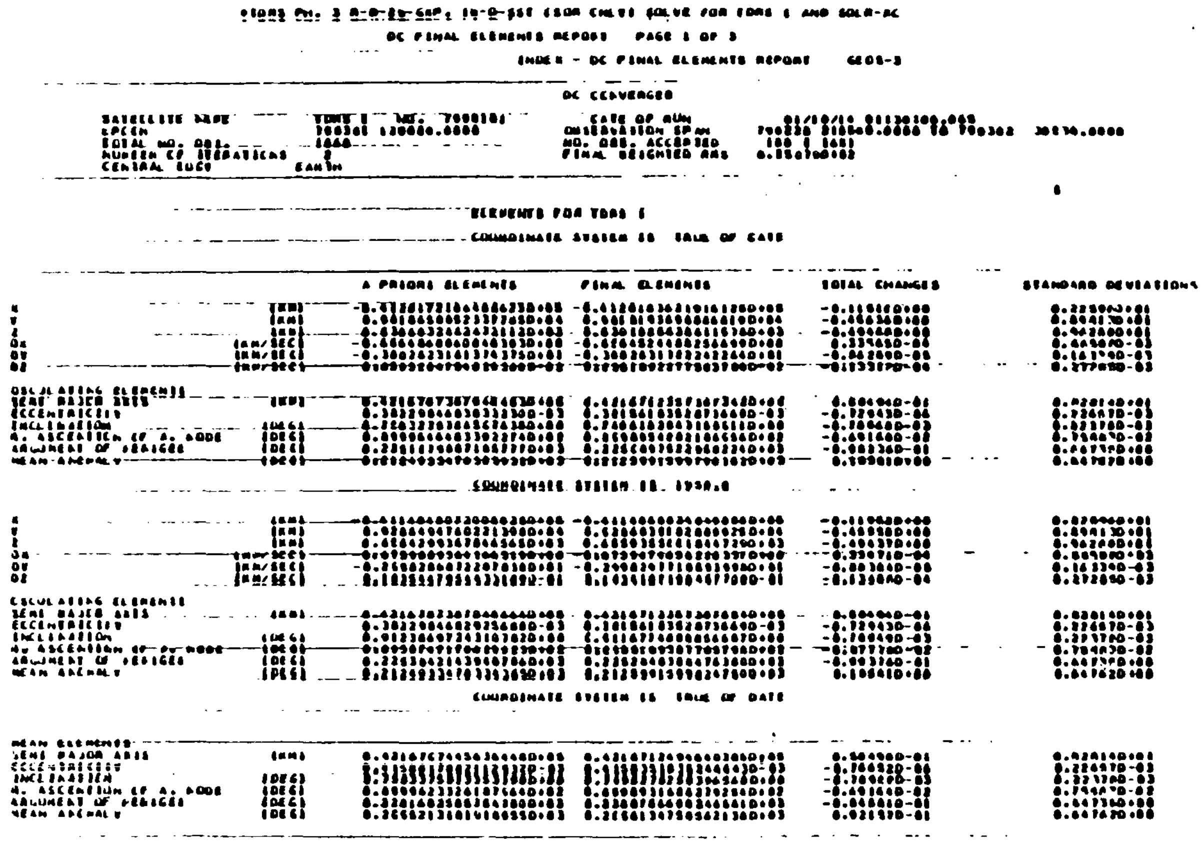


Figure H-20. Differential Correction Final Elements Report (1 of 2)

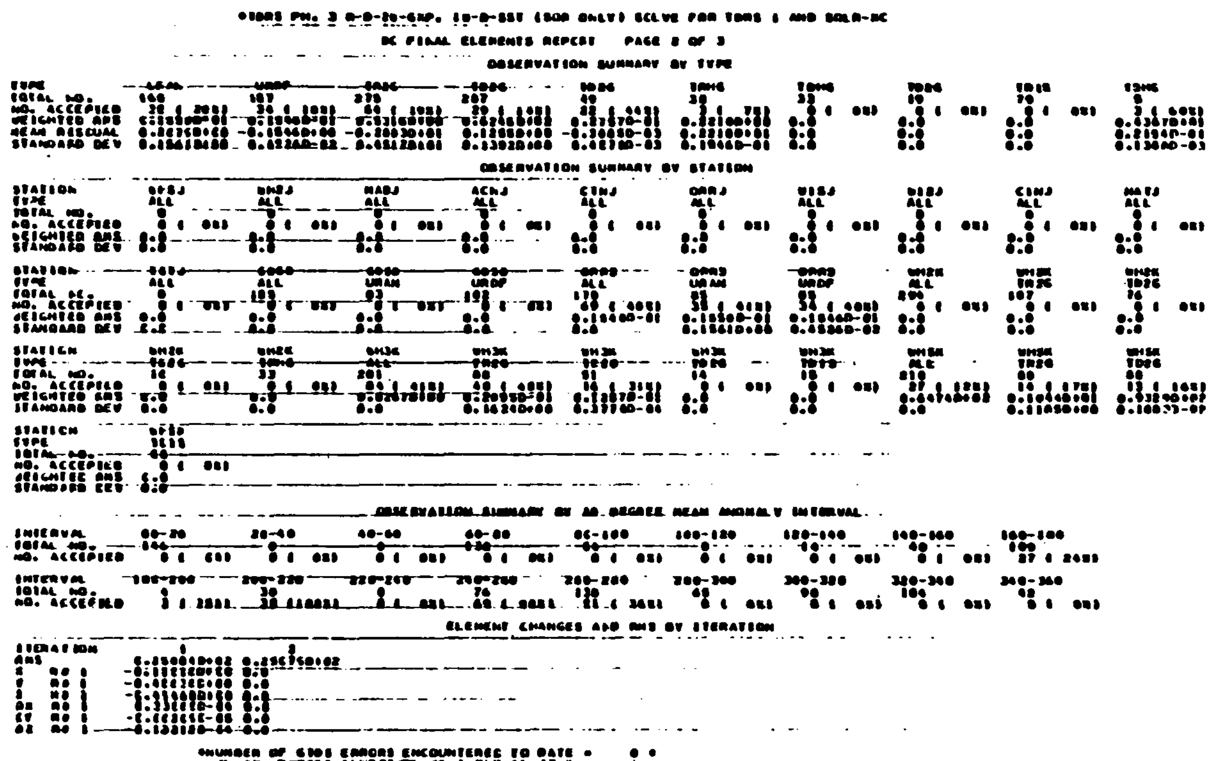


Figure H-20. Differential Correction Final Elements Report (2 of 2)

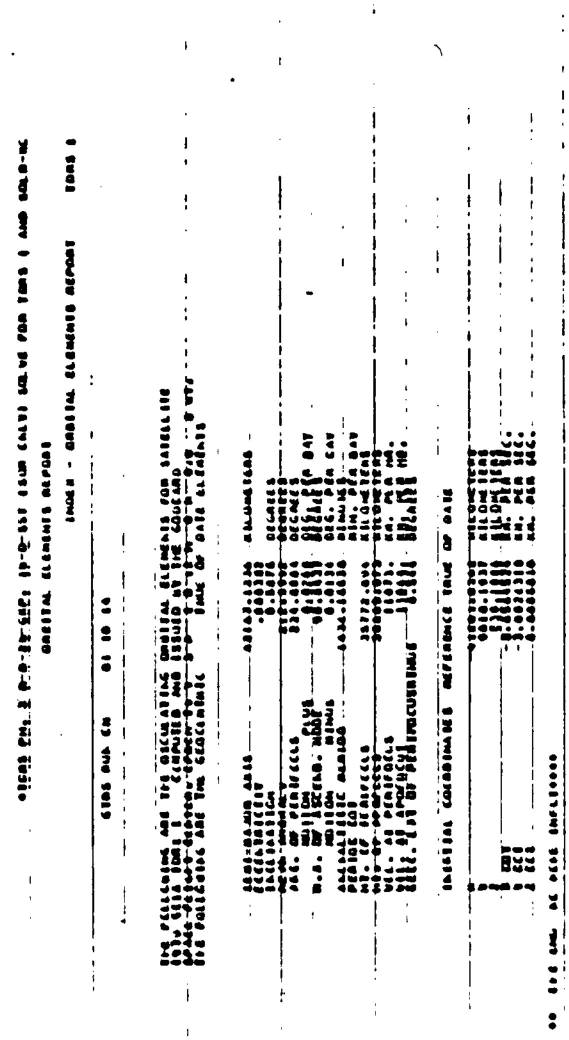


Figure H-21. Orbital Elements Report

H.3.10 SOR CATEGORY SUMMARY REPORT

Figure H-22 is an example of the Category Summary Report based on the final differential correction vector. This report summarizes the category validation statistics for edited and unedited observations and lists the parameters used in the maximum O-C test and the iterative N-sigma test. For each category, the Doppler count interval, the maximum O-C value, the weight, unit, means, and standard deviations for both edited and unedited observations, the number of edited and unedited observations, the SOR sigma multiplier value, and the maximum and actual numbers of loops associated with the iterative N-sigma test are given.

H.3.11 SOR BATCH DETAIL REPORT

The SOR Batch Detail Report (Figure H-23) consists of three parts. Part one is the batch header, which contains information pertaining to the particular batch. Part two is the detailed content, which comprises the time tag, observed value, O-C value, and associated data quality flags for each observation in the batch. The final part includes a report of the batch calibration statistics for each measurement type for both edited and unedited observations and the station validation statistics for both edited and unedited observations. Part three also includes a summary of the noise analysis for each measurement type and indicates whether the divided difference noise analysis or variate difference noise analysis was used.

H.3.12 SOR RECAP OF BATCHED (O-C) SUMMARIES REPORT

The SOR Recap of Batched (O-C) Summaries Report (Figure H-24) consists primarily of the summary of the batch validation statistics by batch number. A brief report of the data arclengths in the Differential Correction and the SOR Programs is given at the beginning.

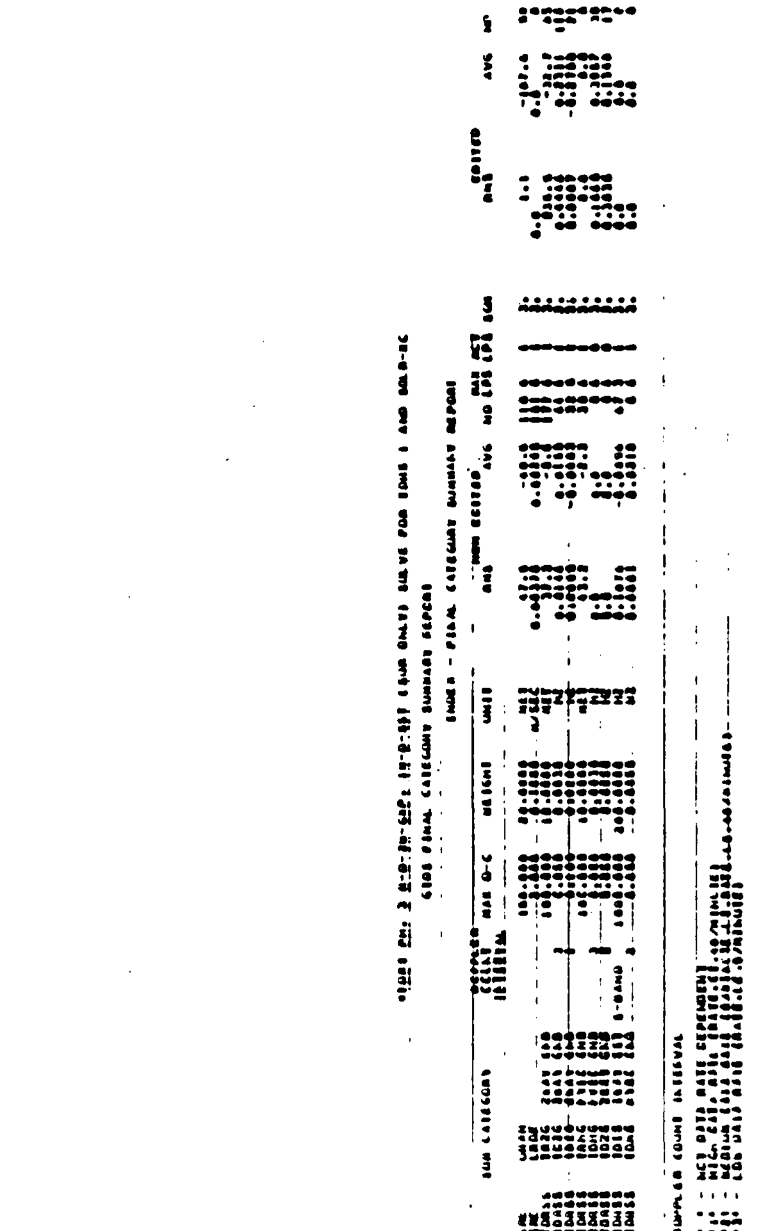


Figure H-22. Category Summary Report

GTDS SOR BATCH DETAIL REPORT

INDEX - INP WH3K WH3K 21MAY89 03.40.20,R 3,SSA2/2,F 3,SSA2,O=1,

```
DATE OF OBS   MISSN=ERBS                      BATCH NO.  5     INPUT       VECTOR
 21 MAY 89     USER= 8410802     RCV TRACKER = WH3K   RTN LINK -    FWD LINK -   USER-TO-TDRS FREQ =  2287.473360 MHZ   NRML SERVICE
  DAY 141       VIC= 1          XMIT TRACKER = WH3K    TDRS= 1302     TDRS= 1302 PILOT TRANSL FREQ = 11410.000000 MHZ   MLDH USER B
         RANGE EXTR =  4        TRACKER SYST = TDRS    SRVC= SSA2/2   SRVC= SSA2          XPDR DELAY =     36.5 M       10SEC DPLR CH
                                DOPPLER EXTR = 14     CHAIN=SOUTH   CHAIN=SOUTH
```

TIME HH MM SS	OBSERVATIONS RANGE (RT/2) KM	OBSERVATIONS RT AVG DOPPLER HZ	O-C VALUES RANGE M	O-C VALUES DOPPLER HZ	RTRN BM OC DEG	RTN LNK HT OF RPS	RTN LNK TDRS CTR ANG	RTN LNK TDRS OP ANG	FWD LNK HT OF RPS	FWD LNK TDRS CTR ANG	FWD LNK TDRS OP ANG	USER HEIGHT KM	USER TA DEG	DATA FLAGS RDCPLXOB	RF AM
03 40 20.	79562.588V	158064.8037V	-4080.V	108333.2919V	0.000	605	62	49	0	0	0	605.	79	RDC------	6
03 41 00.	79436.271S	47454.2901S	-3910.$	-65.2375$	0.000	605	61	49	0	0	0	605.	81	---------	6
03 41 40.	79315.892S	45155.6594S	-3737.$	-67.9672$	0.000	605	60	49	0	0	0	606.	84	---------	6
03 42 20.	79201.671S	42777.5630S	-3554.$	-70.5705$	0.000	606	59	49	0	0	0	606.	88	---------	6
03 43 00.	79093.804S	40324.5458S	-3366.$	-73.0813$	0.000	606	58	49	0	0	0	607.	93	---------	6
03 43 40.	78992.482S	37801.4855S	-3171.$	-75.4455$	0.000	606	57	49	0	0	0	607.	98	---------	6
03 44 20.	78897.881	35213.3892S	-2970.$	-77.7117$	0.000	606	56	49	0	0	0	608.	104	---------	6
03 45 00.	78810.160	32565.6059S	-2763.$	-79.8033$	0.000	607	55	49	0	0	0	609.	111	---------	6
03 45 40.	78729.470	29863.5612S	-2551.$	-81.7658$	0.000	607	54	50	0	0	0	609.	119	---------	6
03 46 20.	78655.942	27112.9366S	-2333.$	-83.5677$	0.000	607	54	50	0	0	0	610.	126	---------	6
03 47 00.	78589.693	24319.5167S	-2111.$	-85.2329$	0.000	607	53	50	0	0	0	611.	134	---------	6
03 47 40.	78530.827	21489.3066S	-1885.$	-86.7025$	0.000	607	52	50	0	0	0	611.	141	---------	6
03 48 20.	78479.430	18628.3444S	-1656.$	-88.0014$	0.000	608	52	50	0	0	0	612.	148	---------	6
03 49 00.	78435.573	15742.7949S	-1423.$	-89.1227$	0.000	608	52	50	0	0	0	613.	154	---------	6
03 49 40.	78399.308	12838.9036S	-1189.$	-90.0496$	0.000	608	51	50	0	0	0	613.	159	---------	6
03 50 20.	78370.676	9922.9285S	-952.$	-90.7989$	0.000	608	51	50	0	0	0	614.	164	---------	6
03 51 00.	78349.697	7001.1595S	-712.	-91.3753$	0.000	608	51	50	0	0	0	615.	167	---------	6
03 51 40.	78336.374	4079.9317S	-473.	-91.7312$	0.000	608	51	50	0	0	0	616.	171	---------	6
03 52 20.	78330.699	1165.4795S	-232.	-91.8857$	0.000	608	51	50	0	0	0	616.	173	---------	6
03 53 00.	78332.640	-1736.0138S	7.	-91.8489$	0.000	608	51	51	0	0	0	617.	176	---------	6
03 53 40.	78342.158	-4618.4506S	250.	-91.6319$	0.000	608	51	51	0	0	0	618.	178	---------	6

BATCH O-C SUMMARY

*** VALIDATION ***

TIME YYMMDD HHMMSS	RANGE (M) SDV	RANGE (M) MEAN	RANGE (M) NO	RANGE PCT. ED.	DOPPLER (HZ) SDV	DOPPLER (HZ) MEAN	DOPPLER (HZ) NO	DOPPLER PCT. ED.	MIN ELV
890521 034020	340.0	-232.0	5	75.0	0.00000	0.00000	0	100.0	13.4
890521 035340	918.9	-2504.7	15*		8.54606	-83.17658	20*		

DATA FLAGS SUM: R = 1 D = 1 C = 1 P = 0 L = 0 X = 0 O = 0 B = 0

*... EDITED POINTS
F... EDITED POINTS VALIDITY INDICATOR

EDIT FLAGS

S = EDIT BY DC SIGMA CRITERIA
* = EDIT BY SOR VALIDATION STATISTICS
E = EDIT BY ELEVATION ANGLE
V = EDIT BY VALIDITY FLAG
M = EDIT BY SCOPE
G = EDIT BY OBSERVATION IN ORBIT FILE GAP
N = DATA NOT AVAILABLE

U = EDIT BY USER IN DC
$ = EDIT BY MAXIMUM O-C IN SOR STATISTICS
A = EDIT BY ATMOSPHERIC INTERFERENCE
D = EDIT BY DOPPLER
T = NOT INCLUDED IN NORMAL MATRIX
+ = DUPLICATE OBSERVATION
C = RANGE CONFIGURATION CHANGED

NOISE FLAGS

N = INSUFFICIENT % OF DIFFS. RELATIVE TO UNEDITED AND N-SIGMA EDITED CALIB. P
P = NO CONVERGENCE WITHIN MAXIMUM ORDERS
L = NO CONVERGENCE WITHIN MAXIMUM INTERN EDIT LOOPS

Figure H-23. SOR Batch Detail Report (for non-DSN Mark IVA Data)

GTDS SOR BATCH DETAIL REPORT

BATCH NO. 4 INPUT VECTOR

DATE OF OBS. SATELLITE NAME=HAW3 RECEIVING-STATION=DS42 TYPE=DSN FREQUENCY= 2069.112500 MHZ
24 SEP 75 SATELLITE NO. =7503301 TRANSMIT -STATION=DS43 TYPE=DSN FREQUENCY= 2069.112500 MHZ TRANS DELAY= 234.0 M
DOPPLER = 3-WAY RECEIVER NUMBER= 2 FIRST COMPONENT= 5 LAST COMPONENT= 4 0 SEC DOPPLER COUNT

	O					O-C						DATA FLAGS	
TIME HH MM SS SS	ANGLE 1 DEG	ANGLE 2 DEG	ELV DEG	RANGE KM	R/R M/S	ANGLE 1 DEG	ANGLE 2 DEG	RANGE M	R/R M/S	HT KM	TA	RD*A	RAM
14 08 24 00	0.000	0.000	5.7	2918.191C	6347.6462S	0.000	0.000	-13161.$	-33.7492$	900	91	---A	0
14 08 30 00	0.000	0.000	5.4	2955.654C	6356.2849	0.000	0.000	-14013.$	-29.5066$	905	91	---A	
14 08 36 00	0.000	0.000	5.1	2993.163C	6364.1904	0.000	0.000	-14842.$	-25.4210$	910	92	---A	0
14 08 42 00	0.000	0.000	4.8	3030.714C	6371.3968	0.000	0.000	-15647.$	-21.4855$	915	92	---A	0
14 08 48 00	0.000	0.000	4.5	3068.305C	6377.9364	0.000	0.000	-16431.$	-17.6934$	921	92	---A	0
14 08 54 00	0.000	0.000	4.2	3105.930C	6383.8398	0.000	0.000	-17193.$	-14.0383$	926	93	---A	0
14 09 00 00	0.000	0.000	3.9	3143.586C	6389.1360	0.000	0.000	-17935.$	-10.5138$	931	93	---A	0
14 09 06 00	0.000	0.000	3.6	3181.270C	6393.8524	0.000	0.000	-18657.$	-7.1139$	936	94	---A	0
14 09 12 00	0.000	0.000	3.3	3218.978C	6398.0147	0.000	0.000	-19359.$	-3.8330$	941	91	---A	0
14 09 18 00	0.000	0.000	3.1	3256.708C	6401.6483	0.000	0.000	-20043.$	-0.6647	946	94	---A	0
14 09 24 00	0.000	0.000	2.8	3294.457C	6404.7763	0.000	0.000	-20709.$	2.3961$	952	95	---A	0
14 09 30 00	0.000	0.000	2.5	3332.221C	6407.4208	0.000	0.000	-21357.$	5.3545$	957	95	---A	0
14 09 36 00	0.000	0.000	2.2	3369.998C	6409.6024	0.000	0.000	-21989.$	8.2152$	962	95	---A	0
14 09 42 00	0.000	0.000	2.0	3407.785C	6411.3414	0.000	0.000	-22604.$	10.9833$	967	96	---A	0
14 09 48 00	0.000	0.000	1.7	3445.580C	6412.6572	0.000	0.000	-23203.$	13.6639$	972	96	---A	0
14 09 54 00	0.000	0.000	1.4	3483.380C	6413.5715	0.000	0.000	-23787.$	16.2651$	977	96	---A	0
14 10 00 00	0.000	0.000	1.2	3521.183C	6414.1008	0.000	0.000	-24355.$	18.7904$	983	97	---A	C
14 10 06 00	0.000	0.000	0.9	3558.987C	6414.2544	0.000	0.000	-24909.$	21.2372$	988	97	---A	0

BATCH O-C SUMMARY

*** VALIDATION ***

TIME YYMMDD HHMMSS	ANGLE 1 SDV	ANGLE 1 MEAN	ANGLE 1 NO	ANGLE 1 PCT ED.	ANGLE 2 SDV	ANGLE 2 MEAN	ANGLE 2 NO	ANGLE 2 PCT ED.	RANGE SDV	RANGE MEAN	RANGE NO	RANGE PCT ED	RANGE-RATE SDV	RANGE-RATE MEAN	RANGE-RATE NO	RANGE-RATE PCT ED
750924 140000	0.000	0.000	0	0.	0.000	0.000	0	0.	0.0	0.0	0	100	0.00000	0.66474	1	99
750924 141006	0.000	0.000	0*		0.000	0.000	0*		315507.8	381651.8	71*		1456.80652	643.89691	70*	

* EDITED POINTS
F. EDITED POINTS VALIDITY INDICATOR

EDIT FLAGS

S = EDIT BY DC SIGMA CRITERIA
* = EDIT BY SOR VALIDATION STATISTICS
E = EDIT BY ELEVATION ANGLE
V = EDIT BY VALIDITY FLAG
M = EDIT BY SCOPE
G = EDIT BY OBSERVATION IN ORBIT FILE GAP
N = DATA NOT AVAILABLE
U = EDIT BY USER IN DC
$ = EDIT BY MAXIMUM O-C IN SOR STATISTICS
A = EDIT BY ATMOSPHERIC INTERFERENCE
D = EDIT BY DOPPLER
T = NOT INCLUDED IN NORMAL MATRIX
+ = DUPLICATE OBSERVATION
C = RANGE CONFIGURATION CHANGED

NOISE FLAGS

N = INSUFFICIENT % OF DIFFS RELATIVE TO UNEDITED AND N-SIGMA EDITED CALIB. PTS
P = NO CONVERGENCE WITHIN MAXIMUM ORDERS
L = NO CONVERGENCE WITHIN MAXIMUM INTERNAL EDIT LOOPS

Figure H-23a. SOR Batch Detail Report (for DSN Mark IVA Data)

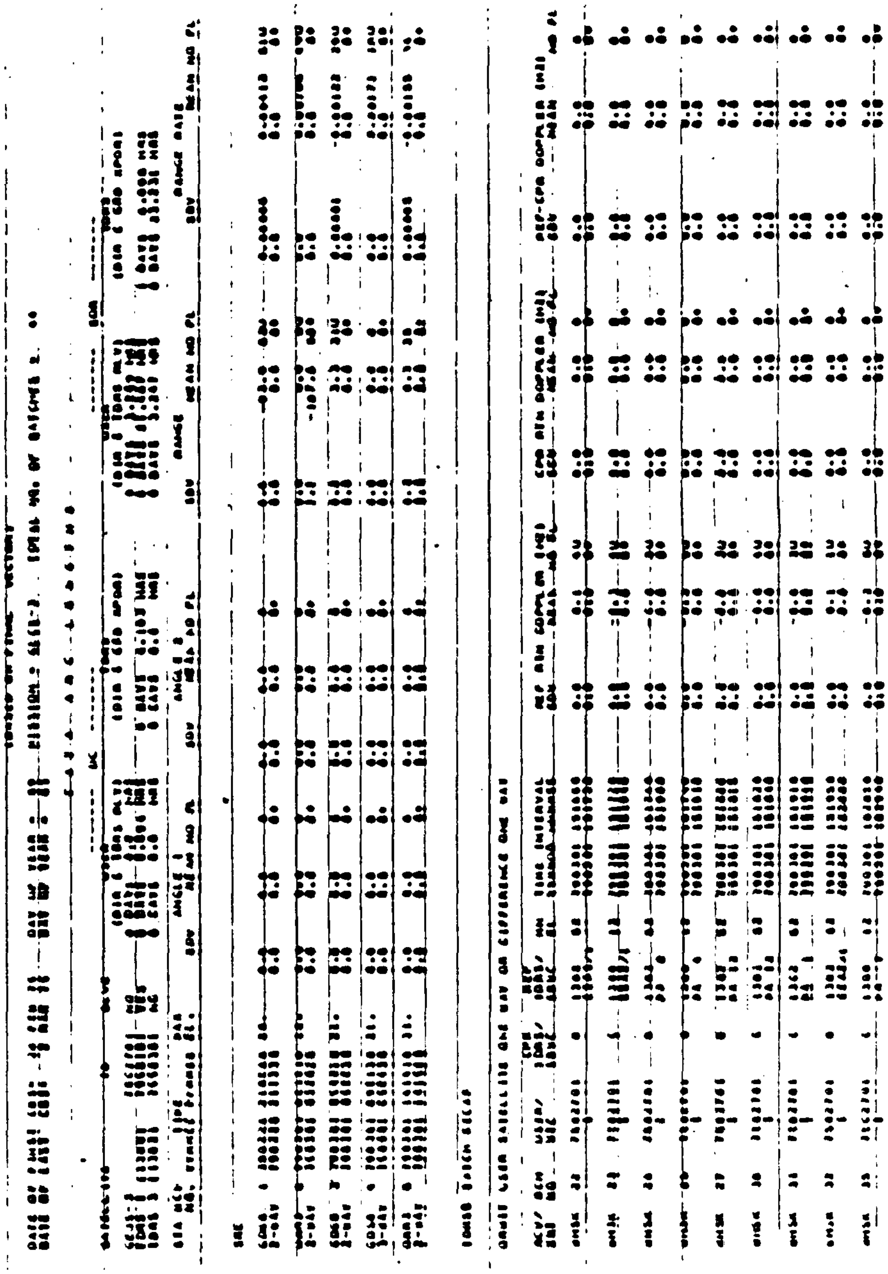


Figure H-24. SOR Recap of Batched Report (1 of 3)

TICRS PT. 2 R-D-2R-GXP, 1R-D-SST (SOR ONLY) SOLVE FOR TDRS 1 AND SOLR-KC

GTDS RECAP OF BATCHED FINAL (O-C) SUMMARIES

RCV/ XMT	SCH NO	USER/ VIC	CPS SDRS/ SRVC	REF SDRS/ SRVC	MN EL	TIME INTERVAL YYMMDD HHMMSS	REF ATN DOPPLER (HZ) SDV	MEAN	NO FL	CPS ATN DOPPLER (HZ) SDV	MEAN	NO FL	REF-CPS DOPPLER (HZ) SDV	MEAN	NO FL
WH2K	38	TDS2701 1	C	1302 PA 6	52	790301 102930 790301 103140	0.0 0.0	-0.1 0.0	13U 0	0.0 0.0	0.0 0.0	0. 0.	0.0 0.0	0.0 0.0	0. 0.
WHSK	40	TDS2701 1	C	1300 PA 8	12	790301 102950 790301 103150	0.0 0.0	-0.1 0.0	12U 0	0.0 0.0	0.0 0.0	0. 0.	0.0 0.0	0.0 0.0	0. 0.
WHSK	41	TDS2701 1	C	1300 PA 6	12	790301 103200 790301 103300	0.0 0.0	-0.0 0.0	6U 0	0.0 0.0	0.0 0.0	0. 0.	0.0 0.0	0.0 0.0	0. 0.

GROUND TRANSPONDER TWO WAY CR HYBRID

RCV/ XMT	SCH NO	USER/ VIC	RTN SDRS/ SRVC	FWD SDRS/ SRVC	MN EL	TIME INTERVAL YYMMDD HHMMSS	RANGE (RT/2) (M) SDV	MEAN	NO FL	DOPPLER (RT TIME AVGD) (HZ) SDV	MEAN	NO FL
WH2K WH2K	6	ORRJ 1	1301 PA 6	1302 PA	-22	790228 101000 790228 102000	0.0 0.0	0.0 0.0	0. 0.	0.0 0.0	0.0 0.0	0. 0.
WH2K WH2K	7	MAIJ 1	1302 PA 1	1302 SSA1	13	790228 225000 790228 231000	2.1 0.0	96.7 100.6	13U 10	0.0 0.0010	0.0 -0.0023	0U 12
WH2K WH2K	8	WHSJ 1	1300 SSA1/1	1300 SSA1	01	790228 234000 790228 234005	0.0 0.0	0.0 155.2	0U 60	0.0 0.0003	0.0 -0.2718	0U 50
WH2K WH2K	9	WPSJ 1	1301 SSA1/1	1302 UNDEF	01	790228 234005 790228 234010	0.0 0.0	0.0 155.2	0U 50	0.0 0.0004	0.0 -0.2712	0U 40
WH2K WH2K	10	WHSJ 1	1302 SSA1/1	1302 UNDEF	01	790228 234011 790228 234015	0.0 0.0	0.0 155.2	0U 50	0.0 0.0004	0.0 -0.2700	0U 40
WH2K WH2K	11	WHIJ 1	1302 SSA2/2	1302 UNDEF	01	790228 234016 790228 234020	0.0 0.0	0.0 155.3	0U 50	0.0 0.0004	0.0 -0.2700	0U 40
WH2K WH2K	12	WSSJ 1	1302 SSA2/2	1302 UNDEF	01	790228 234031 790228 234035	0.0 0.0	0.0 155.0	0U 50	0.0 0.0003	0.0 -0.2607	0U 40
WH3K WH3K	13	TDSJ 1	1302 SSA1/1	1302 SSA1	46	790228 235910 790301 000210	0.0 0.0	0.0 144.0	0U 210	0.0 0.0036	0.0 -0.0101	0U 100
WH3K WH3K	14	CIA 1	1306 SSA1/1	1300 SSA1	12	790301 005050 790301 050050	0.2 0.0	-46.9 0.0	13U 00	0.0 0.0018	0.0 -0.1062	0U 120
WH2K WH3K	15	LIAJ 1	1301 SSA1/1	1300 SSA1	12	790301 045920 790301 050120	0.1 0.0	27.0 0.0	2U 60	0.0 0.0006	0.0 0.1163	0U 60
WH3K WH3K	16	TDSJ 1	1302 SSA1/1	1300 SSA1	10	790301 045930 790301 050130	0.1 0.0	49.9 0.0	7U 60	0.0 0.0001	0.0 0.3243	0U 60
WH3K WH3K	17	TDSJ 1	1300 SSA1/1	1300 SSA1	12	790301 045955 790301 050100	0.0 0.0	48.7 0.0	14U 00	0.0 0.0006	0.0 -0.0779	0U 130
WHSK WHSK	18	CIA 1	1305 SSA2/1	1300 SSA1	18	790301 065500 790301 075000	2.3 0.0	-17.0 0.0	12U 00	0.0110 0.0	0.0311 0.0	11U 00
WH2K WH2K	19	TDSJ 1	1301 SSA1/1	1302 SSA2	46	790301 000000 790301 001200	1.1 0.0	26.6 0.0	13U 00	0.0 0.0076	0.0 0.2026	0U 130
WHSK WHSK	20	WRSJ 1	1300 SSA1/2	1300 SSA1	13	790301 000000 790301 001000	1.6 0.0	-42.8 0.0	10U 00	0.0022 0.0	0.0056 0.0	10U 00
WH3K WH3K	21	WHRJ 1	1306 UNDEF	1300 SSA1	13	790301 111240 790301 111000	0.1 0.0	0.0 0.0	17 0	0.0000 0.0	-0.0000 0.0	16 0
WHSK WHSK	26	WHSJ 1	1301 SSA1/1	1302 SSA1	52	790301 151750 790301 152050	0.1 0.0	-10.0 0.0	15 0	0.0 0.0010	0.0 0.2700	0 130
WH3K WHSK	28	WSSJ 1	1300 PA 6	1302 SSA1	-12	790301 151010 790301 151050	0.0 0.0	2.2 0.0	0 0	0.0001 0.0	0.0210 0.0	0 0

Figure H-24. SOR Recap of Batched Report (2 of 3)

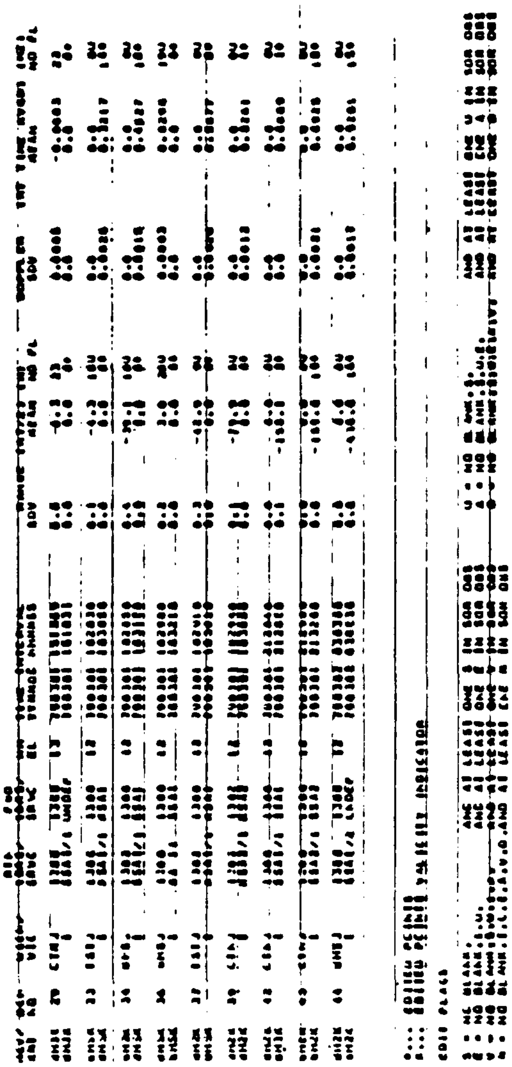


Figure H-24. SOR Recap of Batched Report (3 of 3)

H.3.13 GTDS TRACKER-ORIENTED (O-C) SUMMARIES REPORT

The Tracker-Oriented Final (O-C) Summaries Report (Figure H-25) includes summaries of the differential correction and SOR data arclengths and the station validation statistics for all stations.

H.3.14 TDRS GROUND TRANSPONDER SUMMARY CALIBRATION STATISTICS REPORT

This report, generated exclusively for TDRS ground transponder range data, appears after the Tracker-Oriented (O-C) Summaries Report only when calibration statistics are requested and at least one unedited range O-C (based on calibration statistics) exists for at least one TDRS ground transponder. Two sets of statistics, one for two-way range data and another for hybrid range data, appear for each transponder for which range data appear in SOR. For each transponder, the four-letter transponder acronym and the ground transponder number are given. For both sets of statistics, the following information is listed:

- Number of batches for which at least one unedited range O-C (based on calibration statistics) exists
- Mean value of batch O-C means
- Standard deviation of batch O-C means
- Mean of batch O-C standard deviations
- Standard deviation of batch O-C standard deviations
- Total number of range O-Cs that are unedited and related to the set
- Identifier of each TDRS associated with the set
- Flag indicating the Differential Correction Program edit status

An example appears in Figure H-26.

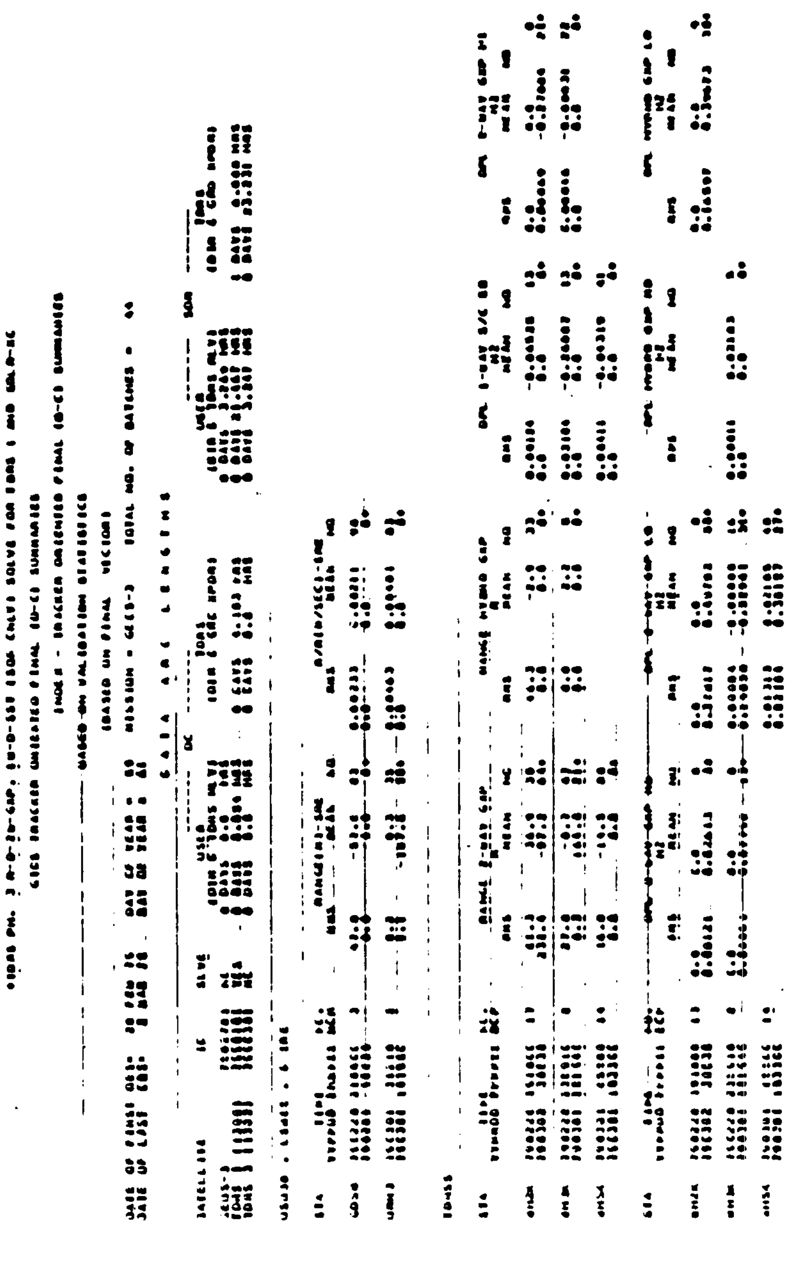


Figure H-25. GTDS Tracker-Oriented (O-C) Summaries Report

OTCRS Pt. 3 R-D-2U-GHP, 1U-D-SST (SOR ONLY) SOLVE FOR TDRS 1 AND SOLR-RC

TDRS GROUND TRANSPONDER SUMMARY CALIBRATION STATISTICS

(BASED ON FINAL VECTOR)

		*** TWO-WAY RANGE ***								*** HYBRID RANGE ***						
XPONDER	SCP	AVGAVG	RMSAVG	AVGRMS	RMSRMS	NUM	TDRS ID	FL	BCH	AVGAVG	RMSAVG	AVGRMS	RMSRMS	NUM	TDRS ID	FL
DMSJ 1	1	[illegible]	[illegible]	0.1	0.4	87	3 1		1	-20.1	0.0	0.0	0.0	10	1 2	U
CTNJ 16	1	-20.4	22.7	0.1	0.1	83	1 3		1	27.0	0.0	0.1	0.0	7	1 3	U
CARJ 18	1	-21.1	21.1	0.0	0.0	36	3 1		1	2.2	0.0	0.0	0.0	5	3 1	
CINJ 25	1	[illegible]	0.0	[illegible]	0.0	12	1	U								
NATJ 35	1	52.7	0.0	2.1	0.0	13	3	U		4						
TBIJ 43	1	21.2	10.2	0.3	0.3	11	3 1	V	2	13.2	50.1	0.2	0.1	16	1 3	U

FLAGS

S = NO BLANK, AND AT LEAST ONE S IN SOR OBS
E = NO BLANK,S,U, AND AT LEAST ONE E IN SOR OBS
V = NO BLANK,S,U,E,A, AND AT LEAST ONE V IN SOR OBS
R = NO BLANK,S,U,E,A,V,B, AND AT LEAST ONE R IN SOR OBS
U = NO BLANK,S, AND AT LEAST ONE U IN SOR OBS
A = NO BLANK,S,U,E, AND AT LEAST ONE A IN SOR OBS
B = NO BLANK,S,U,E,A,V, AND AT LEAST ONE B IN SOR OBS

NORMAL COMPLETION OF JOB

Figure H-26. TDRS Ground Transponder Summary Calibration Statistics Report

H.4 FILTER (FILTER) PROGRAM OUTPUT

The Filter Program is presently not maintained in GTDS.

H.5 EARLY ORBIT DETERMINATION (EARLYORB) PROGRAM OUTPUT

The EARLYORB Program output consists of two reports.

- Early Orbit Input Observations Report
- Converged Resulting Elements Report

Both reports are generated automatically each time an EARLYORB computation is performed.

H.5.1 EARLY ORBIT INPUT OBSERVATIONS REPORT

The Early Orbit Input Observations Report (Figure H-27) first indicates the method of early orbit determination used--Range and Angles, Gauss, or Double-r Iteration. This is followed by a table listing the observation time (year, month, day, hours, minutes, seconds), station ID, observation type, uncorrected observation and observation number. Exactly 6 observations are required for the angles-only (Gauss and Double-r Iteration) methods, and 6 to 48 are needed for the Range and Angles method.

H.5.2 CONVERGED RESULTING ELEMENTS REPORT

The Converged Resulting Elements Report (Figure H-28) lists the epoch time, followed by the computed elements in Cartesian, Keplerian, and spherical coordinates. The elements are computed in the true-of-date reference system. Following the elements are the true anomaly at each epoch time and a key to the abbreviations used in the report.

H.6 DATA SIMULATION (DATASIM) PROGRAM OUTPUT

These four reports are available for any GTDS Data Simulation Program run:

- Initial Conditions Report
- Simulated Observations Report

GTDS EARLYORB PROGRAM

EARLY ORBIT INPUT OBSERVATIONS

TYPE OF STARTER = AUTOMATIC GAUSS METHOD

OBSERVATION TIME YYMMDD HHMMSS.SSSS	STATION ID.	OBSERVATION TYPE	UNCORRECTED OBSERVATION	OBSERVATION NO.
750924 135706.0000	BDAQ	AZ	212.9231	1
750924 135706.0000	BDAQ	EL	1.5230	2
750924 140006.0000	BDAQ	AZ	228.7486	202
750924 140006.0000	BDAQ	EL	29.8931	203
750924 140306.0000	BDAQ	AZ	359.5358	436
750924 140306.0000	BDAQ	EL	39.2106	437

Figure H-27. Early Orbit Input Observations Report

```
GEOS EARLYORB PROGRAM
CONVERGED RESULTING ELEMENTS FROM EARLY ORBIT PROGRAM

THIS IS FINALLY SOLVED BY AUTOMATIC GAUSS METHOD
EPOCH TIME = SEPT 26, 1978,   16 HRS.  0 MIN.  0.0000 SEC

CARTESIAN COORDINATES (KM,KM/SEC)
      X    = [illegible]        Y    = [illegible]        Z    = [illegible]
      DX   = [illegible]        DY   = [illegible]        DZ   = [illegible]

KEPLERIAN COORDINATES (KM,DEGREES)
      SMA  = [illegible]        ECC  = [illegible]        INC  = [illegible]
      LAN  = [illegible]        AP   = [illegible]        MA   = [illegible]

SPHERICAL COORDINATES (KM,DEGREES)
      RA   = [illegible]        DEC  = [illegible]        VPA  = [illegible]
      AZ   = [illegible]        RMAG = [illegible]        VMAG = [illegible]

          TA   =  [illegible]

*****************************************************
*                                                   *
*          DEFINITION OF ABBREVIATIONS              *
*                                                   *
*     X,Y,Z = POSITION IN KM                        *
*  DX,DY,DZ = VELOCITY IN KM/SEC                    *
*       SMA = SEMI-MAJOR AXIS IN KM                 *
*       ECC = ECCENTRICITY                          *
*       INC = INCLINATION IN DEG                    *
*       LAN = LONGITUDE OF ASCENDING NODE IN DEG    *
*        AP = ARGUMENT OF PERIFOCUS IN DEG          *
*        MA = MEAN ANOMALY IN DEG                   *
*        RA = RIGHT ASCENSION IN DEG                *
*       DEC = DECLINATION IN DEG                    *
*       VPA = VERTICAL FLIGHT PATH ANGLE IN DEG     *
*        AZ = VELOCITY AZIMUTH IN DEG               *
*      RMAG = MAG. OF POSITION VECTOR IN KM         *
*      VMAG = MAG. OF VELOCITY VECTOR IN KM/SEC     *
*                                                   *
*****************************************************
```

Figure H-28. Converged Resulting Elements Report

- DATASIM Summary Report
- Station Contact Report

The first report is always generated; the following three are controlled by the user via the DSPEA3 keyword card.

H.6.1 INITIAL CONDITIONS REPORT

Figure H-29 is an example of the DATASIM Initial Conditions Report, which contains three basic types of information:

- Orbital information
- General DATASIM information
- Station information

Orbital information (see Figure H-29, pages 1 and 2) includes spacecraft data such as satellite name and number, start and end times of the input ephemeris file, and the initial spacecraft state.

General DATASIM information (Figure H-29, page 3) includes those data that are station-independent. Such station-independent data includes start and end times of the run, type of tracking schedule, type of output file requested, rate at which satellite passes are determined, type of input ephemeris file, observation correction information, and the standard deviations used for computing noise in the data.

The station information section of the report (all pages after page 3) contains the geodetic coordinates of the stations, station-dependent observation correction information, time and observation biases, observation output rate, and output interval information.

H.6.2 SIMULATED OBSERVATIONS REPORT

Figure H-30 is an example of the Simulated Observation Report. By default, every simulated observation is included in this report. On request, however, the user may elect to print only every nth observation (see keyword card DSPEA3).

```
                              GTDS  DATASIM  PROGRAM
                        GTDS INITIAL CONDITIONS REPORT
                               DATA SIMULATION
                            GTDS  DATASIM  PROGRAM

CURRENT TIME MAY 20, 198[illegible], [illegible] HRS, [illegible] MIN, [illegible] SEC              SCOPES NOT  IN USE
SATELLITE NAME          [illegible]
SATELLITE NUMBER        [illegible]
SATELLITE CONFIGURATION:
     SATELLITE IS SPHERICAL
     DIAMETER               =  [illegible]  METERS      COEFFICIENT OF DRAG USED FOR THE RUN =  [illegible]
     MASS                   =  [illegible]  KG
     AERO VARIATION (ANGLE) =  [illegible]
     REFLECTIVITY CONSTANT  =  [illegible]     AREA FOR RADIATION PRESSURE =  [illegible]  M**2

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

                          TRAJECTORY INITIAL CONDITIONS
                            (AS SPECIFIED AS INPUT DATA)
                                CASE NUMBER        1
               EPOCH TIME                    =APR 1[illegible], 1977,  [illegible] HRS, [illegible] MIN,  [illegible] SEC
               END  TIME                     =APR 1[illegible], 1977,  [illegible] HRS,  [illegible] MIN,  [illegible] SEC
               REFERENCE DATE OF INPUT       =APR 1[illegible], 1977
               TIME SPAN FOR THIS FLIGHT     =   [illegible] DAYS        [illegible] HRS
               PRINT START TIME              =APR 1[illegible], 1977   [illegible] HRS, [illegible] MIN,     [illegible]   SEC
               PRINT INTERVAL                =        [illegible] SEC
```

Figure H-29. DATASIM Initial Conditions Report (1 of 5)

```
GTCS DATASIM PROGRAM
GTDS INITIAL CONDITIONS REPORT

INITIAL STATE
DCDS PARAMETERS ELEMENTS INPUT
CENTRAL BODY = EARTH          TRUE OF REFERENCE

CARTESIAN COORDINATES
   X    [illegible]          Y    [illegible]          Z    [illegible]
   DX   [illegible]          DY   [illegible]          DZ   [illegible]
KEPLERIAN ELEMENTS
   SMA  [illegible]          ECC  [illegible]          INC  [illegible]
   LAN  [illegible]          AP   [illegible]          MA   [illegible]
SPHERICAL COORDINATES
   RA   [illegible]          DEC  [illegible]          VPA  [illegible]
   AZ   [illegible]          RMAG [illegible]          VMAG [illegible]
OTHER PARAMETERS (REFERENCED TO CENTRAL BODY AND COORDINATE FRAME OF INTEGRATION)
   EA   [illegible]          P    [illegible]          SLR  [illegible]
   PA   [illegible]          APR  [illegible]          PH   [illegible]
   APH  [illegible]          C3   [illegible]          TA   [illegible]
   LAT  [illegible]          LON  [illegible]          HGHT [illegible]

DEFINITION OF ABBREVIATIONS

   X,Y,Z = POSITION IN KM
DX,DY,DZ = VELOCITY IN KM/SEC
     SMA = SEMI-MAJOR AXIS IN KM
     ECC = ECCENTRICITY
     INC = INCLINATION IN DEG
     LAN = LONGITUDE OF ASCENDING NODE IN DEG
      AP = ARGUMENT OF PERIFOCUS IN DEG
      MA = MEAN ANOMALY IN DEG
      EA = ECCENTRIC ANOMALY IN DEG
       P = PERIOD IN MIN
     SLR = SEMI-LATUS RECTUM IN KM
      PR = PERIFOCAL RADIUS IN KM
     APR = APOFOCAL RADIUS IN KM
      PH = MEAN PERIFOCAL HEIGHT IN KM
     APH = MEAN APOFOCAL HEIGHT IN KM
      C3 = ENERGY IN (KM/SEC)**2
      TA = TRUE ANOMALY IN DEG
      RA = RIGHT ASCENSION IN DEG
     DEC = DECLINATION IN DEG
     VPA = VERTICAL FLIGHT PATH ANGLE IN DEG
      AZ = VELOCITY AZIMUTH IN DEG
    RMAG = MAGNITUDE OF POSITION VECTOR IN KM
    VMAG = MAGNITUDE OF VELOCITY VECTOR IN KM/SEC
     LAT = LATITUDE IN DEG
     LON = LONGITUDE IN DEG
    HGHT = HEIGHT IN KM
```

Figure H-29. DATASIM Initial Conditions Report (2 of 5)

GTDS INITIAL CONDITIONS REPORT
DATA SIMULATION PROGRAM

START TIME OF RUN IS APR [illegible], 1977 [illegible]HRS [illegible]MINS [illegible]SECS
END TIME OF RUN IS APR 17, 1977 [illegible]HRS [illegible]MINS [illegible] SECS
TRACKING SCHEDULE IS A FUNCTION OF THE INPUT TRACKING SCHEDULE
OUTPUT TAPE IS IN [illegible] FORMAT
RATE AT WHICH TO DETERMINE SATELLITE PASSES IS EVERY [illegible]SECS
MAXIMUM REFERENCE NUMBER OF THE [illegible] FILE IS 20
ORBIT FILE IS [illegible]
INITIAL REVOLUTION NUMBER IS 0
OBSERVATION CORRECTION SWITCH IS ON
MINIMUM ELEVATION ANGLE FOR REFRACTION CORRECTION IS [illegible]DEGREES

DELTA RANGE CORRECTION TABLE

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-29. DATASIM Initial Conditions Report (3 of 5)

```
GTDS INITIAL CONDITIONS REPORT
DATA SIMULATION PROGRAM

STATION INFORMATION

MCA3          TRANSMITTER 1  TYPE-USB30        FREQUENCY-2200.000 MHZ
                              HEIGHT            LATITUDE                                    LONGITUDE
              COORDINATES    -0.034 KM          32 31  [illegible] (DDD MM [illegible])    [illegible] (DDD MM [illegible])
              ERROR           0.0   M            0  0  0.0     (    MM [illegible])          0  0  0.0  (    MM [illegible])
              MINIMUM ELEVATION ANGLE IS   0.0  DEGREES
              LIGHT TIME CORRECTION SWITCH IS ON
              IONOSPHERIC REFRACTION CORRECTION SWITCH IS ON
              TROPOSPHERIC REFRACTION CORRECTION SWITCH IS ON
              ANTENNA MOUNT CORRECTION SWITCH IS OFF
              TRANSPONDER DELAY CORRECTION SWITCH IS ON
              RATE TO COMPUTE OBSERVATION IS EVERY   60.000 SECONDS WITH A TIMING BIAS OF    0.0   SECONDS
              OBSERVATION TYPES TO BE COMPUTED ARE          URDP
              WITH AN OBSERVATION BIAS OF                   0.0
              NUMBER OF INTERVALS IS    1
                  INTERVAL      START TIME                     END TIME
                     1      [illegible]  [illegible]  [illegible]      [illegible]  [illegible]  0.0
              NUMBER OF PERIODIC INTERVALS IS    1
              PERIODIC FREQUENCY OF INPUT INTERVALS IS     [illegible] MHZ
```

Figure H-29. DATASIM Initial Conditions Report (4 of 5)

GTDS INITIAL CONDITIONS REPORT
DATA SIMULATION PROGRAM

STATION INFORMATION

[illegible] TRANSMITTER 1 TYPE=[illegible] FREQUENCY=[illegible] MHZ

COORDINATES HEIGHT [illegible] KM LATITUDE [illegible] LONGITUDE [illegible]
SIGMA [illegible] M 0 0 0.0 [illegible] 0 0 0.0 [illegible]

MINIMUM ELEVATION ANGLE IS 0.0 DEGREES

LIGHT TIME CORRECTION SWITCH IS ON

IONOSPHERIC REFRACTION CORRECTION SWITCH IS ON

TROPOSPHERIC REFRACTION CORRECTION SWITCH IS ON

ANTENNA MOUNT CORRECTION SWITCH IS OFF

TRANSPONDER DELAY CORRECTION SWITCH IS ON

RATE TO GENERATE OBSERVATION IS EVERY [illegible] SECONDS WITH A TIMING BIAS OF 0.0 SECONDS

OBSERVATION TYPES TO BE COMPUTED ARE UADP

WITH AN OBSERVATION BIAS OF 0.0

NUMBER OF INTERVALS IS 1

INTERVAL 1 START TIME [illegible] END TIME [illegible]

NUMBER OF PERIODIC INTERVALS IS 1

PERIODIC FREQUENCY OF INPUT INTERVALS IS [illegible] HRS

Figure H-29. DATASIM Initial Conditions Report (5 of 5)

SIMULATED OBSERVATIONS

DATE	TIME	STATION	TYPE	OBSERVATION	MODEL EFFECTS	LIGHT CORRECT	RANDOM ERROR	ELV	LAT	LON	HEIGHT	TRUE ANMLY	REV NO.
770416	231202.000	QUIS	URDF	[illegible]	-0.122C-03	0.0	0.2870-04	16.2	3.8	269.6	0.4312240D+03	18.9	27
770416	231302.000	QUIS	URDF	[illegible]	-0.431D-04	0.0	0.2040-04	14.9	5.0	272.9	0.4316640D+03	20.6	27
770416	231402.000	CLIS	LRDF	[illegible]	-0.124C-04	0.0	-0.2780-04	14.7	6.2	276.3	0.4321620D+03	22.4	27
770416	[illegible]	QUIS	URDF	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24.3	27
770416	231602.000	QUIS	URDF	[illegible]	0.194C-04	0.0	0.2730-04	18.4	9.3	283.0	0.4332610D+03	26.2	27
770416	231702.000	MI23	URDF	[illegible]	-0.177C-03	0.0	-0.1810-04	1.6	15.7	284.8	0.4338730D+03	28.3	27
770416	231702.000	QLIS	URDF	[illegible]	[illegible]	0.0	-0.3000-04	[illegible]	10.7	[illegible]	0.4338730D+03	28.3	27
770416	231802.000	MI23	URDF	[illegible]	0.800D-04	0.0	0.3420-04	1.6	12.0	289.9	0.4345190D+03	30.4	27
770416	231802.000	CLIS	URDF	[illegible]	[illegible]	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	27
770416	231902.000	MI23	URDF	[illegible]	0.473D-03	0.0	0.2360-05	[illegible]	13.3	293.4	0.4351910D+03	32.7	27
770416	231902.000	CLIS	LRDF	[illegible]	0.419C-03	0.0	0.1400-04	1.4	13.3	253.4	0.4351910D+03	32.7	27
[illegible]	[illegible]	[illegible]	URDF	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	27
770416	232102.000	BCA3	URDF	[illegible]	[illegible]	0.0	0.0230-05	3.6	15.7	300.8	[illegible]	37.8	27
770416	232202.000	BDA3	URDF	[illegible]	0.246C-04	0.0	-0.6920-04	3.4	16.1	304.1	0.4373210D+03	40.1	27
770416	232302.000	BCA3	URDF	[illegible]	0.190D-03	0.0	-0.2300-04	[illegible]	17.0	307.0	[illegible]	[illegible]	27
770416	232402.000	BDA3	URDF	[illegible]	0.670D-03	0.0	-0.0190-04	[illegible]	18.7	311.4	0.4387770D+03	43.6	27

Figure H-30. Simulated Observations Report

When n is set equal to zero, the report is suppressed. When generated, the report contains the following information for each observation:

- Greenwich time of the observation (This is the time uncorrected for bias or light time.)
- Station name and observation type
- Observation value (This value is the vacuum observation with biases, random errors, and modeling effects.)
- Model effects, light time correction, and random errors. (Model effects include refraction correction, transponder delay, and antenna mount corrections. Random errors contain biases and noise.)
- Elevation angle and orbital data (Orbital data consist of geodetic latitude, longitude, height, true anomaly, and the revolution number.)

H.6.3 DATASIM SUMMARY REPORT

Figure H-31 is a sample of the DATASIM Summary Report. The first page contains the start and end times of the DATASIM Program run, the number of stations involved, and two brief summaries of the number of observations and passes (reported by observation type). This section of the DATASIM Program Summary Report is printed with every DATASIM Program run.

The remainder of the report (see Figure H-30, page 2) is included by default but may be omitted on request via the DSPEA3 keyword card. It includes a station-by-station report of the following data for each interval defined in

GTDS DATA SIMULATION PROGRAM SUMMARY

		YYMMDD	HHMMSS.SSS
START TIME OF DSF RUN IS		77C418	[illegible].000
END TIME OF DSF RUN IS		77C417	[illegible].000
NUMBER OF STATIONS IS	8		

OBSERVATION SUMMARY BY STATION

STATION	BCA3	MIL3	ACN3	MAC8	GWM3	HAW3	GDS8	GUIS
NO OF OBS	79	113	123	19	145	140	70	165
NO OF PASSES	11	14	18	4	19	16	10	22

OBSERVATION SUMMARY BY TYPE

OBS TYPE	LRCF
NO OF OBS	942

MEASUREMENT STANDARD DEVIATIONS

MEASUREMENT TYPE	SIGMA VALUE	SIGMA UNITS
LNCFLSH	2.3888	CM/SEC

Figure H-31. DATASIM Summary Report (1 of 3)

```
              [illegible]                    [illegible]                       METERS
        LAT= [illegible]          LONG = [illegible]       HEIGHT = [illegible]
ERROR        [illegible]                 [illegible]                  [illegible]
TOTAL        [illegible]                 [illegible]                  [illegible]

INTERVAL 1
      START TIME    = [illegible]   TIME MIN EL = [illegible]   NO. OF PASSES= [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 1
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 2
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 3
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 4
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 5
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 6
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 7
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 8
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 9
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 10
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]
PASS 11
      START TIME    = [illegible]   TIME MIN EL = [illegible]   TIME ACCURACY  [illegible]
      END TIME      = [illegible]   MIN EL ANGLE= [illegible]   NO. OF OBS.  = [illegible]
      TIME 1ST OB   = [illegible]   TIME MAX EL = [illegible]   1ST REV NO.  = [illegible]
      TIME LAST OB  = [illegible]   MAX EL ANGLE= [illegible]   LAST REV NO. = [illegible]

ALL TIMES ARE IN SYNMOD [illegible]          TIME ACCURACY--> 0= START & END TIMES ACCURATE
ANGLES ARE IN DEGREES                                         1= START TIME ACCURATE
                                                              2= END TIME ACCURATE
                                                              3= START & END TIME INACCURATE
```

Figure H-31. DATASIM Summary Report (2 of 3)

```
       DDDD MM SS.SSS        DDDD MM SS.SSS         METERS
 M123       LAT=  28 38 27.853 LONG = 279 18 23.883 HEIGHT =   -56.428
      ERROR        0  0  0.0            0  0  0.0                  0.0
      TOTAL    -  28 38 27.853          279 18 23.883            -56.428

           INTERVAL  1
                      START TIME    = 770415  458  2.000   TIME MIN EL = 770418  724  2.000   NO.OF PASSES=  14
                      END TIME      = 770417  840  0.0     MIN EL ANGLE=           0.280    NO. OF OBS. = 113
                      TIME 1ST OB   = 770415  715  2.000   TIME MAX EL = 770416  457  2.000   1ST REV NO. =   1
                      TIME LAST OB= 770417  738  2.000   MAX EL ANGLE=          30.634    LAST REV NO.=  32
              PASS  1
                      START TIME    = 770415  718  2.000   TIME MIN EL = 770418  724  2.000   TIME ACCURACY   0
                      END TIME      = 770415  724  2.000   MIN EL ANGLE=           0.280    NO. OF OBS. =  10
                      TIME 1ST OB   = 770415  718  2.000   TIME MAX EL = 770415  718  2.000   1ST REV NO. =   1
                      TIME LAST OB= 770415  724  2.000   MAX EL ANGLE=          17.686    LAST REV NO.=   1
              PASS  2
                      START TIME    = 770415  858  2.000   TIME MIN EL = 770415  901  2.000   TIME ACCURACY   0
                      END TIME      = 770415  901  2.000   MIN EL ANGLE=           0.085    NO. OF OBS. =   7
                      TIME 1ST OB   = 770415  858  2.000   TIME MAX EL = 770415  858  2.000   1ST REV NO. =   2
                      TIME LAST OB= 770415  901  2.000   MAX EL ANGLE=           8.673    LAST REV NO.=   2
              PASS  3
                      START TIME    = 770415 2359  2.000   TIME MIN EL = 770416    3  2.300   TIME ACCURACY   0
                      END TIME      = 770416    3  2.300   MIN EL ANGLE=           6.317    NO. OF OBS. =   8
                      TIME 1ST OB   = 770415 2359  2.000   TIME MAX EL = 770416    3  2.000   1ST REV NO. =  12
                      TIME LAST OB= 770416    3  2.000   MAX EL ANGLE=           8.673    LAST REV NO.=  12
              PASS  4
                      START TIME    = 770416  138  2.000   TIME MIN EL = 770416  143  2.000   TIME ACCURACY   0
                      END TIME      = 770416  143  2.000   MIN EL ANGLE=           3.184    NO. OF OBS. =   8
                      TIME 1ST OB   = 770416  138  2.000   TIME MAX EL = 770416  138  2.000   1ST REV NO. =  13
                      TIME LAST OB= 770416  143  2.000   MAX EL ANGLE=          14.818    LAST REV NO.=  13
              PASS  5
                      START TIME    = 770416  314  2.000   TIME MIN EL = 770416  323  2.000   TIME ACCURACY   0
                      END TIME      = 770416  323  2.000   MIN EL ANGLE=           1.219    NO. OF OBS. =  10
                      TIME 1ST OB   = 770416  314  2.000   TIME MAX EL = 770416  318  2.000   1ST REV NO. =  14
                      TIME LAST OB= 770416  323  2.000   MAX EL ANGLE=          27.388    LAST REV NO.=  14
              PASS  6
                      START TIME    = 770416  453  2.000   TIME MIN EL = 770416  502  2.000   TIME ACCURACY   0
                      END TIME      = 770416  502  2.000   MIN EL ANGLE=           1.355    NO. OF OBS. =  10
                      TIME 1ST OB   = 770416  453  2.300   TIME MAX EL = 770416  457  2.000   1ST REV NO. =  15
                      TIME LAST OB= 770416  502  2.000   MAX EL ANGLE=          30.634    LAST REV NO.=  15
              PASS  7
                      START TIME    = 770416  632  2.000   TIME MIN EL = 770416  640  2.000   TIME ACCURACY   0
                      END TIME      = 770416  640  2.000   MIN EL ANGLE=           2.267    NO. OF OBS. =   9
                      TIME 1ST OB   = 770416  632  2.000   TIME MAX EL = 770416  636  2.000   1ST REV NO. =  16
                      TIME LAST OB= 770416  640  2.000   MAX EL ANGLE=          19.846    LAST REV NO.=  16
              PASS  8
                      START TIME    = 770416  812  2.000   TIME MIN EL = 770416  818  2.000   TIME ACCURACY   0
                      END TIME      = 770416  818  2.000   MIN EL ANGLE=           1.120    NO. OF OBS. =   7
                      TIME 1ST OB   = 770416  812  2.000   TIME MAX EL = 770416  814  2.000   1ST REV NO. =  17
                      TIME LAST OB= 770416  818  2.000   MAX EL ANGLE=           6.877    LAST REV NO.=  17
              PASS  9
                      START TIME    = 770416 2317  2.000   TIME MIN EL = 770416 2319  2.000   TIME ACCURACY   0
                      END TIME      = 770416 2319  2.000   MIN EL ANGLE=           1.231    NO. OF OBS. =   3
                      TIME 1ST OB   = 770416 2317  2.000   TIME MAX EL = 770416 2317  2.000   1ST REV NO. =  27
                      TIME LAST OB= 770416 2319  2.000   MAX EL ANGLE=           1.628    LAST REV NO.=  27
              PASS 10
                      START TIME    = 770417   53  2.000   TIME MIN EL = 770417  100  2.000   TIME ACCURACY   0
                      END TIME      = 770417  100  2.000   MIN EL ANGLE=           1.958    NO. OF OBS. =   8
                      TIME 1ST OB   = 770417   53  2.000   TIME MAX EL = 770417   58  2.000   1ST REV NO. =  28
                      TIME LAST OB= 770417  100  2.000   MAX EL ANGLE=          12.828    LAST REV NO.=  28
              PASS 11
                      START TIME    = 770417  231  2.000   TIME MIN EL = 770417  240  2.000   TIME ACCURACY   0
                      END TIME      = 770417  240  2.000   MIN EL ANGLE=           0.351    NO. OF OBS. =  10
                      TIME 1ST OB   = 770417  231  2.000   TIME MAX EL = 770417  235  2.000   1ST REV NO. =  29
                      TIME LAST OB= 770417  240  2.000   MAX EL ANGLE=          21.894    LAST REV NO.=  29
              PASS 12
                      START TIME    = 770417  410  2.000   TIME MIN EL = 770417  410  2.000   TIME ACCURACY   0
                      END TIME      = 770417  419  2.000   MIN EL ANGLE=           0.480    NO. OF OBS. =  10
                      TIME 1ST OB   = 770417  410  2.000   TIME MAX EL = 770417  414  2.000   1ST REV NO. =  30
                      TIME LAST OB= 770417  419  2.000   MAX EL ANGLE=          30.381    LAST REV NO.=  30

           ALL TIMES ARE IN YYMMDD HHMM SS.SSS          TIME ACCURACY--> 0= START & END TIMES ACCURATE
                                                                          1= START TIME ACCURATE
           ANGLES ARE IN DEGREES                                          2= END TIME ACCURATE
                                                                          3= START & END TIME INACCURATE
```

Figure H-31. DATASIM Summary Report (3 of 3)

the tracking schedule and each pass[1] of an interval processed during the DATASIM process.

- Start and end time of the interval/pass (acquisition of signal (AOS) is assumed at the start time; loss of signal (LOS) is assumed at the end time of a pass.)
- Times of the first and last computed observations for the interval/pass
- Time of minimum computed elevation angle and the value of that angle for the interval/pass
- Time of east/west meridian crossing (for Minitrack stations only)
- Time of north/south meridian crossing (for Minitrack stations only)
- Number of observations computed for the interval/pass
- First and last spacecraft revolution numbers for the interval/pass
- Number of passes for the interval

H.6.4 STATION CONTACT REPORT (STATION-PASS REPORT)

The Station Contact Report or Station-Pass Report (Figure H-32) is output only by a user request on keyword card DSPEA3. The report, printed in a matrix form, may be considered as a condensed version of the DATASIM Program Summary Report. The information provided includes the time frames for which the station can observe the satellite (i.e., the times of AOS and LOS), the maximum elevation angle within the time frames, and the local time of AOS.

---

[1]For the satellite-pass mode, interval data are not written, since interval data and pass data are essentially equivalent.

REV NUM START		16 770416 61033	17 770416 74403	18 770416 83734	19 770416 101104	20 770416 122434	21 770416 138805	22 770416 153135	23 770416 170505	24 770416 183836	25 770416 201206	26 770416 214536	27 770416 231907	28 770417 5237	29 770417 22607	30 770417 35537	31 770417 53308
BDA3	AOS	770416 63702											770416 232002	770417 9702	770417 23602	770417 41402	770417 55402
	LOS	770416 64202											770416 232402	770417 10402	770417 24302	770417 42202	770417 55902
	EL MAX	5											4	52	17	15	6
	AOSL	770417 21024											770417 180124	770417 203024	770417 221624	770417 235524	770418 13824
MIL3	AOS	770416 63202	770416 81002									770416 214700		770417 5302	770417 23402	770417 41002	770417 54502
	LOS	770416 64002	770416 81802									770416 221902		770417 10002	770417 24002	770417 41902	770417 55702
	EL MAX	19	7									2		13	26	30	20
	AOSL	770417 10916	770417 24916									770417 135816		770417 193016	770417 210816	770417 224716	770418 2616
ACN3	AOS	770416 62202	770416 83102	770416 101202	770416 115200	770416 132100	770416 151000	770416 164900	770416 182400							770417 43002	770417 60002
	LOS	770416 70102	770416 84002	770416 101902	770416 115502	770416 133502	770416 151902	770416 165802	770416 183202							770417 43802	770417 61002
	EL MAX	65	25	10	7	11	20	52	11							11	30
	AOSL	770417 55644	770417 13344	770417 91444	770417 102444	770417 123344	770417 141244	770417 155144	770417 173144							770418 33244	770418 51044
MAD8	AOS											770416 214602	770416 233402				
	LOS											770416 215002	770416 233802				
	EL MAX											3	3				
	AOSL											770417 213022	770417 231722				
GWM3	AOS	770416 73702	770416 91602		770416 105900	770416 123500	770416 141500	770416 155400	770416 173300	770416 191300							770417 65402
	LOS	770416 74502	770416 92502		770416 110402	770416 124302	770416 142302	770416 160302	770416 174202	770416 192002							770417 70202
	EL MAX	15	70		38	10	20	63	42	9							13
	AOSL	770416 171559	770416 185459		770416 203359	770416 221259	770416 232359	770417 13259	770417 31159	770417 45159							770417 163259
HAW3	AOS	770416 61202	770416 75100	770416 93002	770416 111000	770416 124900	770416 142900								770417 36002	770417 50902	
	LOS	770416 62102	770416 80102	770416 94002	770416 111502	770416 125802	770416 143502								770417 38702	770417 53002	
	EL MAX	26	25	12	67	26	7								9	23	
	AOSL	770416 191322	770416 211222	770416 222122	770417 3122	770417 21022	770417 38022								770417 171322	770417 185022	
GDS8	AOS	770416 60402	770416 80302	770416 94302												770417 40302	770417 54102
	LOS	770416 63102	770416 81002	770416 94702												770417 40902	770417 54802
	EL MAX	11	5	3												6	11
	AOSL	770416 223632	770417 1532	770417 15532												770417 201532	770417 215332

AOS = ACQUISITION OF SIGNAL — ELMAX = MAXIMUM ELEVATION ANGLE THIS PASS
LOS = LOSS OF SIGNAL — AOSL = LOCAL TIME OF AOS

Figure H-32. Station Contact Report (Station-Pass Report)

In addition, the revolution number and the start and end times of the revolution are printed.

H.7 ERROR ANALYSIS (ANALYSIS) PROGRAM OUTPUT

These four basic reports are available for any GTDS Error Analysis Program run:

- Initial Conditions Report
- Summary Tracking Report and Partial Tracking Report
- Error Analysis Summary Report
- Mapping Report

The Initial Conditions Report, Summary Tracking Report, and Error Analysis Summary Report are always produced. The Partial Tracking Report and the Mapping Report are optional and are controlled by the keywords PARTRTMS and MAPTIMES, respectively.

H.7.1 INITIAL CONDITIONS REPORT

This report combines information from the Initial Conditions Reports of the Differential Correction and Data Simulation Programs. The report is designed to reflect those options specified by the user as well as the Error Analysis Program control parameters for the particular case. Figure H-33 contains a sample of this report. The pertinent information in this report may be broken into the following categories.

- Spacecraft-dependent parameters
- Pregenerated ORBIT File options
- Initial Spacecraft state
- Initial state covariance matrix
- Solve-for/consider parameters and noise
- Tracking schedule information
- Station geodetics information
- Error Analysis Program output options

For an Error Analysis Program run, the list of orbit generator options is a statement of options already

```
OUTPUT OPTIONS

MAPPING START TIME        = JULY   2, 1976   1HRS   0MINS  0.0  SECS
MAPPING END TIME          = JULY   [illegible], 1976   2HRS   0MINS  0.0  SECS
MAPPING INTERVAL          =     100.300 SECS
MAPPED VARIANCE-COVARIANCE MATRIX
     YES
MAPPED [illegible] PARAMETER STANDARD DEVIATION BREAKDOWN
     NO
```

Figure H-33. ANALYSIS Initial Conditions Report (1 of 7)

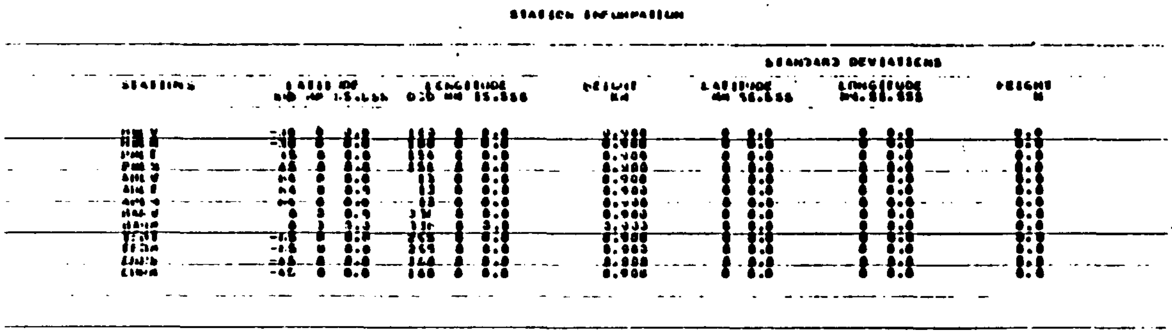


Figure H-33. ANALYSIS Initial Conditions Report (2 of 7)

```
TRACKING SCHEDULE INFORMATION

TRACKING SCHEDULE IS A FUNCTION OF SATELLITE PASSES
RATE AT WHICH TO DETERMINE SATELLITE PASSES IS EVERY     15.00SECS
FORTRAN REFERENCE NUMBER OF THE ORBIT FILE IS   10
ORBIT FILE IS DIRECT
MINIMUM ELEVATION ANGLE IS     0.0 DEGREES
INITIAL REVOLUTION NUMBER IS      0
```

Figure H-33. ANALYSIS Initial Conditions Report (3 of 7)

EPOCH TIME [illegible]

INITIAL CONDITIONS SOLVE AND CONSIDER PARAMETERS

CONSIDER OPTION IS OFF

6 TOTAL PARAMETERS TO BE SOLVED
6 DYNAMIC PARAMETERS
0 STATION LOCATIONS
0 ATTITUDE PARAMETERS
0 RELAY SATELLITE STATE PARAMETERS
0 [illegible] REFLECTIVITY
0 POSSIBLE BIASES
0 TRANSPONDER DELAYS

PARAMETER TYPE	PARAMETER NAME	APRIORI STANDARD DEVIATIONS
STATE (CART) 1	X	[illegible]
	Y	[illegible]
	Z	[illegible]
	DX	[illegible]
	DY	[illegible]
	DZ	[illegible]

THERE ARE NO STATIONS BEING SOLVED

MEASUREMENT STANDARD DEVIATIONS

MEASUREMENT TYPE		SIGMA VALUE	SIGMA UNITS
RANG	GR-VHF	[illegible]	METERS
RRAT	GR-VHF	30.0000	CM/SEC
X30	GR-VHF	[illegible]	SEC-ARC
Y30	GR-VHF	[illegible]	SEC-ARC
L	MINITRK	[illegible]	[illegible]
M	MINITRK	[illegible]	[illegible]
AZ	C-BAND	[illegible]	SEC-ARC
EL	C-BAND	618.7966	SEC-ARC

Figure H-33. ANALYSIS Initial Conditions Report (4 of 7)

INITIAL STATE COVARIANCE MATRIX

	X	Y	Z	DX	DY	DZ
X	0.0	0.0	0.0	0.0	0.0	0.0
Y		0.0	0.0	0.0	0.0	0.0
Z			0.0	0.0	0.0	0.0
DX				0.0	0.0	0.0
DY					0.0	0.0
DZ						0.0

Figure H-33. ANALYSIS Initial Conditions Report (5 of 7)

ADVANCED [illegible] [illegible]

INITIAL EPOCH AND ELEMENTS [illegible] ... CARD FILE.

EPOCH [illegible] 0 HRS. 0 MIN. 0.0 SEC WILL BE USED AS ANCHOR POINT . NO EPOCH ADVANCE OCCURS.

[illegible] FILE ELEMENTS [illegible] CENTRAL BODY = EARTH TRUE OF REFERENCE

CARTESIAN COORDINATES

X	[illegible]	Y	[illegible]	Z	[illegible]
DX	[illegible]	DY	[illegible]	DZ	[illegible]

KEPLERIAN ELEMENTS

SMA	[illegible]	ECC	[illegible]	INC	[illegible]
LAN	[illegible]	AP	[illegible]	TA	[illegible]

SPHERICAL COORDINATES

RA	[illegible]	DEC	[illegible]	VFA	[illegible]
AZ	[illegible]	RMAG	[illegible]	VMAG	[illegible]

OTHER PARAMETERS (REFERENCED TO CENTRAL BODY AND COORDINATE FRAME OF INTEGRATION)

EA	[illegible]	P	[illegible]	SLR	[illegible]
PH	[illegible]	APH	[illegible]	MA	[illegible]
APR	[illegible]	C3	[illegible]	TA	[illegible]
LAT	[illegible]	LON	[illegible]	HGHT	[illegible]

DEFINITIONS OF ABBREVIATIONS

X,Y,Z	= POSITION IN KM	EA	= ECCENTRIC ANOMALY IN DEGREES
DX,DY,DZ	= VELOCITY IN KM/SEC	P	= PERIOD IN MINUTES
SMA	= SEMI-MAJOR AXIS IN KM	SLR	= SEMI-LATUS RECTUM IN KM
ECC	= ECCENTRICITY	PR	= PERIFOCAL RADIUS IN KM
INC	= INCLINATION IN DEGREES	APR	= APOFOCAL RADIUS IN KM
LAN	= RIGHT ASCENSION OF ASCENDING NODE DEGREES	PH	= MEAN PERIFOCAL HEIGHT IN KM
AP	= ARGUMENT OF PERIFOCUS IN DEGREES	APH	= MEAN APOFOCAL HEIGHT IN KM
MA	= MEAN ANOMALY IN DEGREES	C3	= ENERGY IN KM**2/SEC**2
RA	= RIGHT ASCENSION IN DEGREES	TA	= TRUE ANOMALY IN DEGREES
DEC	= DECLINATION IN DEGREES	LAT	= LATITUDE IN DEGREES
VFA	= VERTICAL FLIGHT PATH ANGLE IN DEG	LON	= LONGITUDE IN DEGREES
AZ	= VELOCITY AZIMUTH IN DEGREES	HGHT	= HEIGHT IN KM
RMAG	= MAGNITUDE OF POSITION VECTOR IN KM		
VMAG	= MAGNITUDE OF VELOCITY VECTOR IN KM		

Figure H-33. ANALYSIS Initial Conditions Report (6 of 7)

```
CURRENT TIME [illegible]                                         42.748 SEC                         SCOPES NOT   IN USE

    SATELLITE NAME                  NIMBUS-F
    SATELLITE NUMBER                7503201
    SATELLITE CONFIGURATION:
        SATELLITE IS SPHERICAL
        DIAMETER                 =  [illegible]  METERS         COEFFICIENT OF DRAG USED FOR THE RUN =  0.200000000D+01
        MASS                     =  [illegible]  KG
        AERO. VARIATION (NPOLY)  =  0.0
        REFLECTIVITY CONSTANT    =  0.[illegible]                AREA FOR RADIATION PRESSURE ........=  0.320000000D+01 M**2

* * * * * * * * * * * * * * * * * * * * * * * ORBIT EPHEMERIS OPTIONS * * * * * * * * * * * * * * * * * * * * * * * *

ORBIT GENERATION TYPE-
PREGENERATED "ORBIT" FILE

STATE PARTIALS TYPE-
CARTESIAN USING NUMERICAL INTEGRATION
                        4 X 4 BY 4 GRAVITY FIELD USED IN COMPUTATION OF PARTIALS

NON-STATE PARTIALS (COMPUTED BY NUMERICAL INTEGRATION)-
                                NO NON-STATE PARTIALS CONSIDERED

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

                                TRAJECTORY INITIAL CONDITIONS
                                (AS SPECIFIED BY INPUT DATA)
                                     CASE NUMBER        1
                   EPOCH TIME                  =JULY  2, 1976,   0 HRS,   0 MIN,   0.0   SEC
                   REFERENCE DATE OF INPUT     =JAN   [illegible]
                   TOTAL TRACKING PERIOD       =    0 DAYS          2.06667 HRS
                   TRACKING START TIME         =JULY  2, 1976,   0 HRS,   1 MIN,   0.0   SEC
                   TRACKING END TIME           =JULY  2, 1976,   2 HRS,   5 MIN,   0.0   SEC
```

Figure H-33. ANALYSIS Initial Conditions Report (7 of 7)

exercised in creating the existing pregenerated ORBIT File. Similarly, the spacecraft-dependent parameters, initial spacecraft state, epoch, and reference time of input are retrieved from the pregenerated ORBIT File and are not supplied by the user in the Error Analysis Program run.

The solve-for/consider parameter section of information includes a list of all parameters being solved for or considered, their a priori standard deviations, and a table of all observation measurement standard deviations. Currently in the consider mode, the solve-for parameters are limited to the state parameters.

Included in the Error Analysis Program output options are the partial tracking report times, the mapping report times, and the coordinate system and status of the sensitivity breakdown.

H.7.2 SUMMARY TRACKING REPORT AND PARTIAL TRACKING REPORT

The Summary Tracking Report and the Partial Tracking Report have the same content. The Summary Tracking Report is based on all the observations collected over the entire tracking span, whereas Partial Tracking Reports, which are optional, are based on the observations collected and the normal matrix accumulated up to that tracking time. Figure H-34 contains a sample of the Summary Tracking Report. A Summary Tracking Report or a Partial Tracking Report provides the following information:

- Observation summary by station and by data type

- Epoch variance-covariance matrix (measurement noise alone) and epoch solve-for variance-covariance matrix (consider mode) with associated correlation coefficients. (Since the variance-covariance matrix is symmetric, only the upper triangular portion of the matrix is printed. The lower triangular portion of this printout reflects the

TRACKING UP TO JULY 2, 1976 2 HRS 5 MIN 0.0 SEC

OBSERVATION SUMMARY BY STATION

STATION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NO OF OBS	[illegible]	84	63	42	[illegible]	63	42	84	42	63
NO OF PASSES	2	2	1	1	1	1	1	1	1	1

STATION	[illegible]	[illegible]	[illegible]
NO OF OBS	87	[illegible]	[illegible]
NO OF PASSES	1	2	2

OBSERVATION SUMMARY BY TYPE

OBS TYPE	[illegible]	[illegible]	[illegible]	[illegible]	L	H	AZ	EL
NO OF OBS	[illegible]	126	126	126	[illegible]	[illegible]	63	63

Figure H-34. Summary Tracking Report (1 of 3)

ERROR ANALYSIS TRACKING REPORT

[illegible] EPOCH VARIANCE-COVARIANCE MATRIX AND ASSOCIATED CORRELATED COEFFICIENTS

[illegible]

[illegible]

LOWER TRIANGLE ELEMENTS ARE CORRELATION COEFFICIENTS WITH DIAGONAL ELEMENTS (WHICH ARE EQUAL TO ONE) OMITTED.

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-0.1154	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	0.4252	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-34. Summary Tracking Report (2 of 3)

[illegible] ANALYSIS TRACKING REPORT

[illegible] STANDARD DEVIATIONS OF ELEMENTS AND SOLVE PARAMETERS

AT JULY 2, 1976 0 HRS 0 MIN 0.0 SEC
USING TRACKING TO 30 JULY 2, 1976 2 HRS 5 MIN 0.0 SEC

CARTESIAN COORDINATES		STD. DEV	FLIGHT PARAMETERS		STD. DEV
X	(KM)	[illegible]	ECC ANOMALY	(DEG)	0.4[illegible]D-01
Y	(KM)	0.47[illegible]D-01	TRUE ANOMALY	(DEG)	0.1370D-04
Z	(KM)	0.2[illegible]D-01	PERIOD	(MINUTES)	0.1[illegible]D-03
X DOT	(KM/SEC)	[illegible]	PERIOD DOT	(MIN/DAY)	0.0
Y DOT	(KM/SEC)	[illegible]	APOFOCAL HEIGHT	(KM)	0.1030D-01
Z DOT	(KM/SEC)	[illegible]	APOFOCAL HEIGHT	(KM)	0.1[illegible]D-01
			MEAN MOTION	(MIN/DAY)	[illegible]
KEPLERIAN COORDINATES			ARG PER DOT	(DEG/DAY)	0.[illegible]D-09
SEMI-MAJOR AXIS	(KM)	[illegible]	ASC NOD DOT	(DEG/DAY)	[illegible]D-10
ECCENTRICITY		0.2[illegible]D-05	VEL AT APOGEE	(KM/SEC)	0.1[illegible]D-04
INCLINATION	(DEG)	0.[illegible]D-03	VEL AT PERIG	(KM/SEC)	0.1[illegible]D-04
LONG. OF A. NODE	(DEG)	[illegible]	LATITUDE	(DEG)	[illegible]
ARG. OF PERIGEE	(DEG)	0.4710D-01	LONGITUDE	(DEG)	0.1240D-02
MEAN ANOMALY	(DEG)	0.[illegible]D-01	HEIGHT	(KM)	0.1500D-01
SPHERICAL COORDINATES			ORBIT PLANE COORDINATES		
RIGHT ASCENSION	(DEG)	[illegible]	R	(KM)	[illegible]
DECLINATION	(DEG)	0.[illegible]D-03	C	(KM)	0.[illegible]D-01
FLIGHT PATH ANGLE	(DEG)	0.[illegible]D-03	L	(KM)	0.[illegible]D-01
AZIMUTH ANGLE	(DEG)	[illegible]	R DOT	(KM/SEC)	[illegible]
MAG. OF POS. VECTOR	(KM)	0.[illegible]D-01	C DOT	(KM/SEC)	0.[illegible]D-04
MAG. OF VEL.	(KM/SEC)	[illegible]	L DOT	(KM/SEC)	[illegible]

[illegible] SOLVE PARAMETER REPORT

X	(KM)	0.[illegible]D-01	DX	(KM/SEC)	0.[illegible]D-04
Y	(KM)	0.[illegible]D-01	DY	(KM/SEC)	0.[illegible]D-04
Z	(KM)	[illegible]	DZ	(KM/SEC)	[illegible]

Figure H-34. Summary Tracking Report (3 of 3)

correlation coefficients of the specified solve-for parameters.)[1]

- Standard deviations of elements and solve-for parameters at epoch. (The elements include Cartesian coordinates, Keplerian elements, spherical coordinates, flight parameters, and orbit plane coordinates.)[1]

- Standard deviations (sensitivity breakdown) due to consider parameter effects and noise effects on the solve-for parameters (remaining pages) in a designated coordinate system (in Cartesian, Keplerian, and orbit plane for the Summary Tracking Report; in orbit plane only for the Partial Tracking Report)[1]

H.7.3 ERROR ANALYSIS SUMMARY REPORT

The Error Analysis Summary Report provides a time history of uncertainties, in the epoch state of the satellite, by supplying the following information for each partial tracking interval:

- Tracking times
- Position uncertainty (rms) at epoch
- Velocity uncertainty (rms) at epoch
- Standard deviations of Keplerian elements at epoch

Figure H-35 presents a sample of this report.

H.7.4 MAPPING REPORT

The Error Analysis Program also provides the optional capability to map the epoch covariance matrix, resulting

---

[1]In the event that the normal matrix cannot be successfully inverted, only the observation summary by station and by data type is printed.

ERROR ANALYSIS SUMMARY REPORT

SATELLITE NAME NIMBUS-4 NO. 7505201 DATE OF RUN 81/ 9/23 5 3 56.205

EPOCH 760702 0.0 OBSERVATION SPAN 760702 100.0000 TO 760702 86400.0000

COORDINATE SYSTEM TRUE OF DATE CENTRAL BODY EARTH

TOTAL NO. OF OBS. 1029

TRACKING SUMMARY

	UNCERTAINTIES AT EPOCH		STANDARD DEVIATIONS AT EPOCH					
TRACKING TIME (HRS)	POSITION (M)	VELOCITY (CM/SEC)	SMA (KM)	ECC	INC (DEG)	LAN (DEG)	AP (DEG)	MA (DEG)
[illegible]	0.4053D+02	0.1053D+02	0.5260D-02	0.2024D-08	0.6735D-03	0.6059D-03	0.4764D-01	0.4724D-01

"UNCERTAINTY" IMPLIES ROOT SUM SQUARE OF THE POSITION OR VELOCITY SIGMAS.
THE STANDARD DEVIATIONS REPORTED INCLUDE NOISE AND CONSIDER EFFECTS.

Figure H-35. Error Analysis Summary Report

from the entire tracking span, to other times (Figure H-36). The mapping report supplies the following information:

- Table of trajectory standard deviations of position, velocity, and associated components in a designated coordinate system (Cartesian or orbit plane; shown in orbit plane in the figure)[1]
- Table of trajectory standard deviations of Keplerian elements[1]
- Table of elements standard deviations at the end of mapping interval
- The variance-covariance matrix of the solve-for parameters with associated correlation coefficients, but at last map time only
- Optionally, the sensitivity breakdown of the consider parameters and measurement noise effects on the mapped solve-for parameters in a designated coordinate system (in Cartesian, Keplerian, and orbit plane) at each map time and in all three coordinate systems at last map time

H.8 EPHEMERIS COMPARISON (COMPARE) PROGRAM OUTPUT

Figures H-37 and H-38 show two reports that are part of the minimum printed output generated by the COMPARE Program; both reports are always printed. Included in the Ephemeris Compare Initial Conditions Report is the satellite state vector at epoch in both Cartesian and Keplerian coordinates as retrieved from the input ephemeris files. Included in the Ephemeris Compare Difference Report are the computed

[1]For each standard deviation, the component of that standard deviation due solely to measurement noise is also printed.

MAPPING REPORT

TRAJECTORY STANDARD DEVIATIONS AT TIME SPECIFIED

TIME YYMMDDHHMMSS.S	X (M)	Y (M)	Z (M)	RSP (M)	XDOT (CM/SEC)	YDOT (CM/SEC)	ZDOT (CM/SEC)	RSV (CM/SEC)
[illegible]	0.512850D+02 0.512850D+02	0.438980D+02 0.438980D+02	0.443750D+02 0.443750D+02	[illegible] 0.807860D+02	[illegible] 0.100100D+02	[illegible] 0.294400D+01	[illegible] 0.431540D+01	[illegible] 0.112920D+02
760702011000.0	0.551410D+02 0.551410D+02	0.267020D+02 0.267020D+02	0.620040D+02 0.620040D+02	0.842230D+02 0.842230D+02	0.937900D+01 0.937900D+01	0.469000D+01 0.469000D+01	0.278540D+01 0.278540D+01	0.108540D+02 0.108540D+02
760702012000.0	0.883250D+02 0.883260D+02	0.272850D+02 0.272850D+02	0.638620D+02 0.638620D+02	0.111900D+03 0.111900D+03	0.673800D+01 0.673800D+01	0.451000D+01 0.451000D+01	0.283240D+01 0.283240D+01	0.849550D+01 0.849550D+01
[illegible]	0.101850D+03 0.101850D+03	0.465240D+02 0.465240D+02	0.465630D+02 0.465630D+02	0.120780D+03 0.120780D+03	0.471750D+01 0.471750D+01	0.275920D+01 0.275920D+01	0.423940D+01 0.423940D+01	0.691660D+01 0.691660D+01
760702014000.0	0.850310D+02 [illegible]	0.557170D+02 [illegible]	0.246700D+02 0.246700D+02	0.107630D+03 [illegible]	0.640060D+01 0.640060D+01	0.175550D+01 [illegible]	[illegible] [illegible]	0.872290D+01 0.872290D+01
[illegible]	[illegible] 0.682750D+02	[illegible] [illegible]	0.374570D+02 [illegible]	0.853230D+02 [illegible]	[illegible] [illegible]	0.316000D+01 [illegible]	[illegible] [illegible]	0.112200D+02 [illegible]
[illegible]	[illegible] 0.473190D+02	[illegible] [illegible]	0.476970D+02 0.476970D+02	0.857070D+02 0.857070D+02	[illegible] 0.945410D+01	[illegible] 0.664790D+01	[illegible] 0.467180D+01	0.119630D+02 0.119630D+02

FIRST NUMBER GIVES TOTAL SIGMAS INCLUDING NOISE AND CONSIDER EFFECTS.

SECOND NUMBER GIVES NOISE SIGMAS ONLY.

Figure H-36. Mapping Report (1 of 3)

MAPPING REPORT

TIME TRAJECTORY STANDARD DEVIATIONS AT TIME SPECIFIED

[illegible]	SMA (KM)	ECC	INC (DEG)	LAN (DEG)	AP (DEG)	MA (DEG)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

FIRST NUMBER GIVES TOTAL SIGMAS INCLUDING NOISE AND CONSIDER EFFECTS.
SECOND NUMBER GIVES NOISE SIGMAS ONLY.

Figure H-36. Mapping Report (2 of 3)

MAPPING REPORT

END OF MAPPING ELEMENTS REPORT

DATE JULY 2, 1976 2 HRS 0 MIN 0.0 SEC
ELAPSED TIME FROM EPOCH 0 DAYS 2 HRS 0 MIN 0.0 SEC
POSITION RSM = 85.79 METERS
VELOCITY RSM = 31.84 CM/SEC

ELEMENTS STANDARD DEVIATIONS AT END OF MAPPING INTERVAL

CARTESIAN COORDINATES		STD. DEV	FLIGHT PARAMETERS		STD. DEV
X	(KM)	0.4723D-01	ECC ANOMALY	(DEG)	0.9670D-01
Y	(KM)	0.2323D-01	TRUE ANOMALY	(DEG)	0.2700D-01
Z	(KM)	0.6770D-01	PERIOD	(MINUTES)	0.1980D-03
X DOT	(KM/SEC)	0.5461D-04	PERIOD DOT	(MIN/DAY)	0.0
Y DOT	(KM/SEC)	0.6650D-04	PERIFOCAL HEIGHT	(KM)	0.0160D+00
Z DOT	(KM/SEC)	0.4670D-04	APOFOCAL HEIGHT	(KM)	0.1840D-01
			MEAN MOTION	(MIN/DAY)	0.1770D-00
KEPLERIAN COORDINATES			ARG PER DOT	(DEG/DAY)	0.7210D-04
SEMI-MAJOR AXIS	(KM)	0.5060D-02	ASC NOD DOT	(DEG/DAY)	0.1290D-10
ECCENTRICITY		0.1210D-05	VEL AT APOGEE	(KM/SEC)	0.1310D-04
INCLINATION	(DEG)	0.6730D-03	VEL AT PERIGEE	(KM/SEC)	0.1340D-04
LONG. OF ASC NODE	(DEG)	0.6630D-03	LATITUDE	(DEG)	0.4990D-03
ARG. OF PERIGEE	(DEG)	[illegible]	LONGITUDE	(DEG)	0.4670D-03
MEAN ANOMALY	(DEG)	3.5620-01	HEIGHT	(KM)	0.3030E-01
SPHERICAL COORDINATES			ORBIT PLANE COORDINATES		
RIGHT ASCENSION	(DEG)	0.3540D-03	H	(KM)	0.1580D-01
DECLINATION	(DEG)	0.2610D-03	C	(KM)	0.2260D-01
VT FLT PATH ANG	(DEG)	0.1380D-03	L	(KM)	0.6590D-01
AZIMUTH ANGLE	(DEG)	0.7507D-03	H DOT	(KM/SEC)	0.0100D-04
MAG. OF RADIUS VEC	(KM)	0.1660D-01	C DOT	(KM/SEC)	0.1020D-03
MAG. OF VEL	(KM/SEC)	0.1350D-04	L DOT	(KM/SEC)	0.1350D-04

STDS SOLVE PARAMETER REPORT

X	(KM)	0.4730D-01	DX	(KM/SEC)	0.0450D-04
Y	(KM)	0.2320D-01	DY	(KM/SEC)	0.5610D-04
Z	(KM)	0.6770D-01	DZ	(KM/SEC)	0.4670D-04

VARIANCE-COVARIANCE MATRIX AND ASSOCIATED CORRELATION COEFFICIENTS AT END OF MAPPING INTERVAL

	X	Y	Z	DX	DY	DZ
X	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Y	-0.2170	0.53738470D-01	0.12754340D-02	-0.99241930D-06	-0.11430820D-05	0.75478000D-06
Z	-0.5174	0.8110	0.45074610D-02	-0.27791890D-05	-0.35122520D-05	0.21203020D-05
DX	0.1998	-0.5570	-0.5352	0.89376630D-08	0.32618980D-08	-0.20932350D-08
DY	0.4355	-3.4730	-0.9106	0.0071	0.31099050D-08	-0.20902130D-08
DZ	-0.3643	0.3338	0.0836	-0.4232	-0.9400	0.21028540D-08

Figure H-36. Mapping Report (3 of 3)

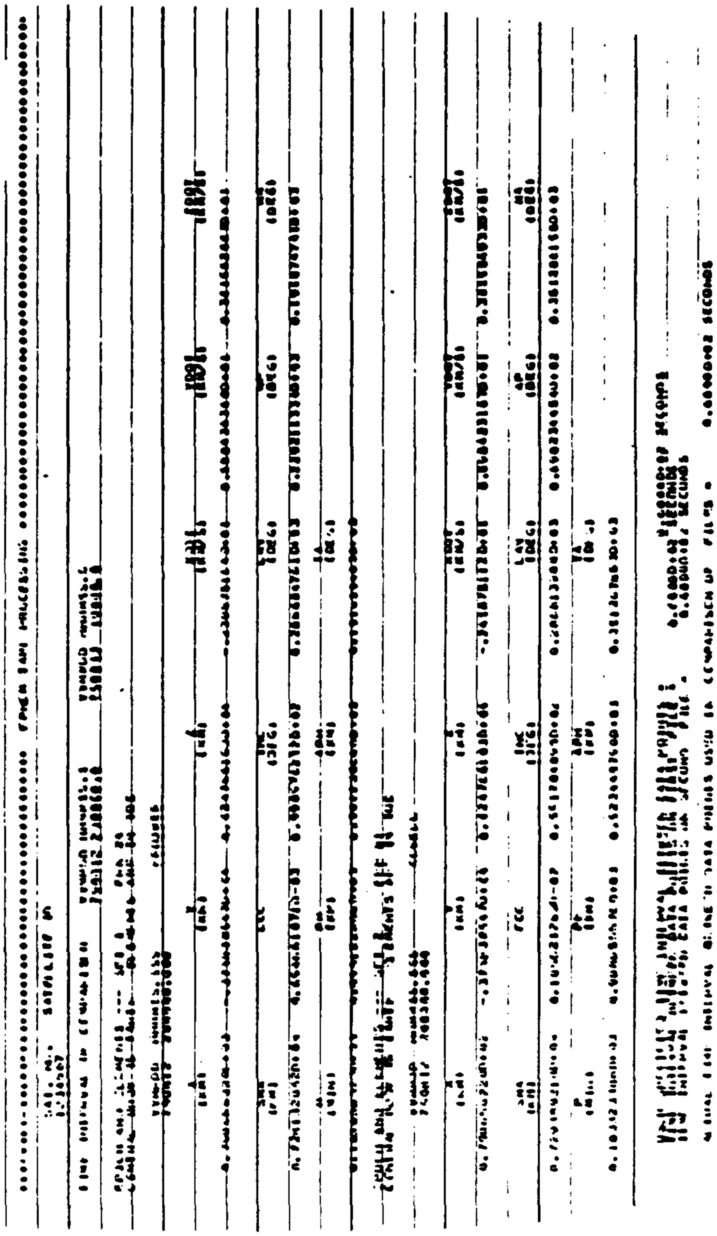


Figure H-37. Ephemeris Comparison Initial Conditions Report

GTDS COMPARE PROGRAM

POSITION DIFFERENCE VECTOR COMPONENTS

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YYMMDD HHMMSS	RANGE NO.1 (KM)	RANGE NO.2 (KM)	RADIAL (KM)	CROSS TRACK (KM)	ALONG TRACK (KM)	DELTA-R (KM)	TRUE ANOMALY TA (DEG)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-38. Ephemeris Comparison Difference Report-Position Differences

difference vectors in both Cartesian and track-oriented coordinates. These differences are printed at each comparison time point. The three possible kinds of Ephemeris Compare Reports, showing position differences, position/velocity differences, and the world map, are shown in Figure H-38, H-39, and H-40, respectively. The third report, which always appears, is the Summary Report shown in Figure H-41.

The only other printer outputs available from the COMPARE Program are in the form of printer plots of the difference vectors and printer plots of Keplerian elements histories. Plots of position and velocity differences in both Cartesian and track-oriented coordinates are available via keyword card CMPPLOT. Figure H-42 and H-43 are examples, respectively, of printer plot of the position and velocity differences of the radial component of the track-oriented coordinates. (For an example of a history plot, see Figure H-11). Only two printer reports are available from the Ephemeris Merge Program. Figures H-44 and H-45 are examples of the EPHEM Merge Initial and Summary Reports, respectively. These are described in Section 3.7.7.

H.9 DATA MANAGEMENT (DATAMGT) PROGRAM OUTPUT

The reports generated by the DATAMGT Program can appear in other GTDS programs that utilize the DATAMGT Program.

The output from the GTDS Data Management Program run consists of up to 11 reports:

- Atmospheric Density Working File Report
- Station Geodetics Working File Report
- Elements Working File Report
- Integration Coefficients Working File Report
- Refraction Working File Report
- Impulsive Maneuvers Working File Report

GTDS COMPARE PROGRAM PAGE 7

EPHEMERIS COMPARE REPORT

YYMMDD HHMMSS	R1(KM) / DX(KM) / DR1(KM)	R2(KM) / DY(KM) / DC2(KM)	V1(KM/SEC) / DZ(KM) / DA3(KM)	V2(KM/SEC) / DVX(KM/SEC) / CV1(KM/SEC)	TA1(DEG) / DVY(KM/SEC) / CV2(KM/SEC)	TA2(DEG) / DVZ(KM/SEC) / CV3(KM/SEC)
790012 230000.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230100.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230200.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230300.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230400.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230500.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230600.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230700.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230800.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 230900.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231000.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231100.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231200.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231300.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231400.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231500.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
790012 231600.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

R1,R2,V1,V2,TA1,TA2 ARE RANGE, VELOCITY AND TRUE ANOMALY OF FILE 1 AND FILE 2 RESPECTIVELY.
DX,DY,DZ,DVX,DVY,DVZ ARE DIFFERENCES OF X,Y,Z,VX,VY,VZ COMPONENTS.
DR1,DC2,DA3 ARE DIFFERENCES OF RADIAL, CROSS-TRACK AND ALONG-TRACK COMPONENTS
CV1,CV2,CV3 ARE DIFFERENCES OF RATE OF CHANGE OF RADIAL, CROSS-TRACK AND ALONG-TRACK COMPONENTS

Figure H-39. Ephemeris Comparison Difference Report-Position/Velocity Differences

GIBS COMPARE PROGRAM PAGE 7

THE WORLD MAP

[illegible]	[illegible]	GEODETIC LATITUDE (DEG)	GEODETIC LONGITUDE (DEG)	SPHEROID HEIGHT (KM)	GEODETIC LATITUDE (DEG)	GEODETIC LONGITUDE (DEG)	SPHEROID HEIGHT (KM)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-40. Ephemeris Comparison Program - World Map

GPS COMPARE PROGRAM

EPHEMERIS COMPARISON SUMMARY REPORT

	MINIMUM POSITION DIFFERENCE			MAXIMUM POSITION DIFFERENCE		
	YYMMDD	HHMMSS.SSS	(KM)	YYMMDD	HHMMSS.SSS	(KM)
RADIAL	[illegible]	[illegible]	[illegible]	790813	2100.000	0.3169187D+02
CROSS TRACK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ALONG TRACK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DELTA-R	[illegible]	[illegible]	[illegible]	790813	0040.000	0.3502150D+03

	POSITION RMS (KM)	VELOCITY RMS (KM/SEC)
RADIAL	[illegible]	0.263440D+00
CROSS TRACK	[illegible]	[illegible]
ALONG TRACK	[illegible]	0.815760D-02
TOTAL	[illegible]	0.263050D+00

Figure H-41. Ephemeris Comparison Summary Report

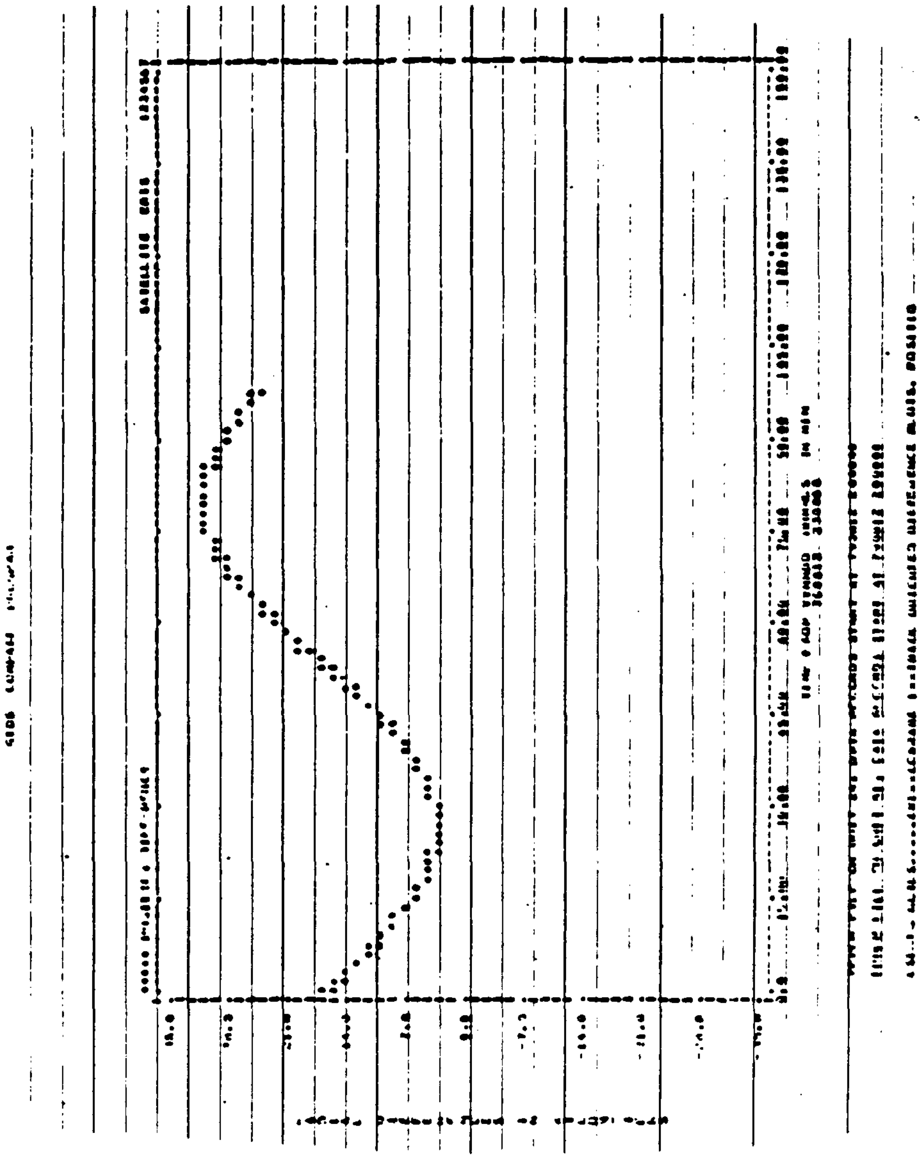

Figure H-42. Ephemeris Comparison Program Difference Plot--Position Differences

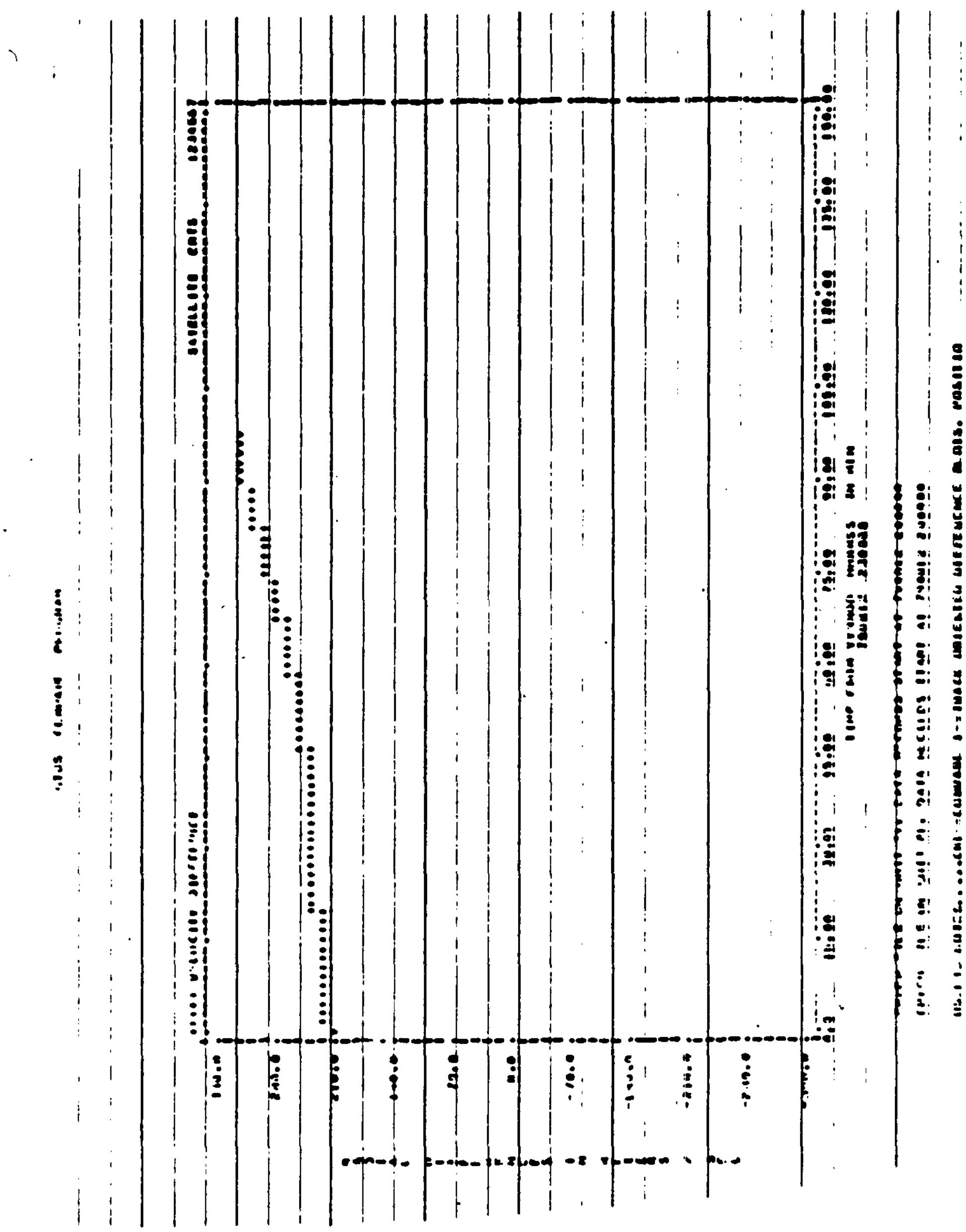

Figure H-43. Ephemeris Comparison Program Difference Plot--Velocity Differences

[illegible] PROGRAM

********************************** INITIAL REPORT OF TWO INPUT EPHEM TAPES ***

SATELLITE NO. [illegible]
SATELLITE ID [illegible]

THE EPOCH AND ELEMENTS OF FIRST SET OF EPHEM TAPE
EPOCH TIME YYMMDD HHMMSEC [illegible]

X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SMA (KM)	**ECC**	**INC (DEG)**	**LAN (DEG)**	**AP (DEG)**	**MA (DEG)**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P (MIN)	**PH (KM)**	**APH (KM)**	**TA (DEG)**		
[illegible]	[illegible]	[illegible]	[illegible]		

THE EPOCH AND ELEMENTS OF SECOND SET OF EPHEM TAPE
EPOCH TIME YYMMDD HHMMSEC [illegible]

X (KM)	Y (KM)	Z (KM)	XDOT (KM/S)	YDOT (KM/S)	ZDOT (KM/S)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SMA (KM)	**ECC**	**INC (DEG)**	**LAN (DEG)**	**AP (DEG)**	**MA (DEG)**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P (MIN)	**PH (KM)**	**APH (KM)**	**TA (DEG)**		
[illegible]	[illegible]	[illegible]	[illegible]		

Figure H-44. MERGE Initial Report

```
                              GTDS  COMPARE  PROGRAM
                                  GTDS MERGE PROGRAM
                                EPHEM MERGE SUMMARY REPORT

                                    YYMMDD HHMMSEC              YYMMDD HHMMSEC
EPHEMERIS NO. 1 TIME SPAN           701228 100000.000     TO    800103 100000.000
EPHEMERIS NO. 2 TIME SPAN           701220      0.0       TO    800104      0.0
USER SPECIFIED MERGE TIME SPAN           0      0.0       TO         0      0.0

ACTUAL MERGED TIME SPAN             701228 100000.000     TO    800104      0.0


                                    YYMMDD HHMMSEC
TIME OF MERGE                       701228 110000.000
DELTA-R AT TIME OF MERGE            0.14065830-03

                  EPHEMERIS NO. 1 POSITION AND VELOCITY VECTOR AT TIME OF MERGE

               X (KM)                          Y (KM)                          Z (KM)
           X-DOT (KM/SEC)                  Y-DOT (KM/SEC)                  Z-DOT (KM/SEC)

           -0.17018950D+04                  0.19000170D+04                  0.68249324D+00
           -0.16858180D+01                  0.46118642D+01                 -0.23115819D+01

                  EPHEMERIS NO. 2 POSITION AND VELOCITY VECTOR AT TIME OF MERGE

               X (KM)                          Y (KM)                          Z (KM)
           X-DOT (KM/SEC)                  Y-DOT (KM/SEC)                  Z-DOT (KM/SEC)

           -0.17018950D+04                  0.19000170D+04                  0.68249324D+00
           -0.16858180D+01                  0.46118642D+01                 -0.23115819D+01

 THE EPHEM MERGED HAS BEEN COMPLETED


NORMAL COMPLETION OF JOB
```

Figure H-45. EPHEM MERGE Summary Report

- Flight-Sectioning Working File Report
- Physical Constants Working File Report
- Solar/Lunar/Planetary (SLP) Ephemeris Working File Report
- Rejected Stations Report
- Detailed Reject/Accept Criteria Report

Only when the proper option card has been used in the DMOPT subdeck will the user receive any of these reports (see Section 3.8).

H.9.1 ATMOSPHERIC DENSITY WORKING FILE REPORT

This report (shown in Figure H-46) presents the requested 1964 Harris-Priester atmospheric model. The number of data sets in the requested density model, the height in kilometers, and the minimum and maximum densities in kilograms/kilometers^3 for each set is reported.

H.9.2 STATION GEODETICS WORKING FILE REPORT

For this report (see Figure H-47), the user requests that either the working file or the permanent file be reported. In both cases, all the stations associated with that file are reported. For each station, the following information is given in tabular form:

- Station name
- Station type
- Station number
- Spherical coordinates (geodetic latitude, geographic longitude, and height)
- Cartesian coordinates (x, y, and z)
- North/south vertical deflection
- East/west vertical deflection

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WORKING ATMOSPHERIC DENSITY FILE REPORT

1966 HARRIS/PRIESTER ATMOSPHERE SPIN-MARK 0-1000 KM F0200 56 SETS IN DENSITY FILE

SET NO.	HEIGHT (KM)	MINIMUM DENSITY (KG/KM**3)	MAXIMUM DENSITY (KG/KM**3)
1	0.0	0.12250000D+10	0.12250000D+10
2	0.20000000D+02	0.88910000D+08	0.88910000D+08
3	0.40000000D+02	0.39957000D+07	0.39957000D+07
4	0.60000000D+02	0.30592000D+06	0.30592000D+06
5	0.80000000D+02	0.19990000D+05	0.19990000D+05
6	0.10000000D+03	0.49740000D+03	0.49740000D+03
7	0.11000000D+03	0.70000000D+02	0.70000000D+02
8	0.12000000D+03	0.24900000D+02	0.24900000D+02
9	0.13000000D+03	0.80400000D+01	0.83410000D+01
10	0.14000000D+03	0.38110000D+01	0.39640000D+01
11	0.15000000D+03	0.21300000D+01	0.22220000D+01
12	0.16000000D+03	0.13130000D+01	0.13060000D+01
13	0.17000000D+03	0.85400000D+00	0.92700000D+00
14	0.18000000D+03	0.59370000D+00	0.65310000D+00
15	0.19000000D+03	0.42300000D+00	0.47770000D+00
16	0.20000000D+03	0.31000000D+00	0.35990000D+00
17	0.21000000D+03	0.22970000D+00	0.27700000D+00
18	0.22000000D+03	0.17320000D+00	0.21990000D+00
19	0.23000000D+03	0.13260000D+00	0.17520000D+00
20	0.24000000D+03	0.10290000D+00	0.14200000D+00
21	0.25000000D+03	0.80730000D-01	0.11710000D+00
22	0.26000000D+03	0.63900000D-01	0.96090000D-01
23	0.27000000D+03	0.51170000D-01	0.80800000D-01
24	0.28000000D+03	0.41240000D-01	0.67800000D-01
25	0.29000000D+03	0.33490000D-01	0.57350000D-01
26	0.30000000D+03	0.27360000D-01	0.48830000D-01
27	0.32000000D+03	0.18300000D-01	0.35790000D-01
28	0.34000000D+03	0.12600000D-01	0.26470000D-01
29	0.36000000D+03	0.87700000D-02	0.20350000D-01
30	0.38000000D+03	0.62060000D-02	0.15600000D-01
31	0.40000000D+03	0.44410000D-02	0.12070000D-01
32	0.42000000D+03	0.32100000D-02	0.94170000D-02
33	0.44000000D+03	0.23430000D-02	0.74110000D-02
34	0.46000000D+03	0.17230000D-02	0.58740000D-02
35	0.48000000D+03	0.12760000D-02	0.46860000D-02
36	0.50000000D+03	0.95060000D-03	0.37600000D-02
37	0.52000000D+03	0.71220000D-03	0.30330000D-02
38	0.54000000D+03	0.53420000D-03	0.24640000D-02
39	0.56000000D+03	0.40370000D-03	0.20010000D-02
40	0.58000000D+03	0.30030000D-03	0.16350000D-02
41	0.60000000D+03	0.23540000D-03	0.13410000D-02
42	0.62000000D+03	0.18050000D-03	0.11040000D-02
43	0.64000000D+03	0.13900000D-03	0.91190000D-03
44	0.66000000D+03	0.10760000D-03	0.75570000D-03
45	0.68000000D+03	0.83720000D-04	0.62670000D-03
46	0.70000000D+03	0.65490000D-04	0.52100000D-03
47	0.72000000D+03	0.51530000D-04	0.43590000D-03
48	0.74000000D+03	0.40800000D-04	0.36430000D-03
49	0.76000000D+03	0.32530000D-04	0.30550000D-03
50	0.78000000D+03	0.26130000D-04	0.25670000D-03
51	0.80000000D+03	0.21130000D-04	0.21670000D-03
52	0.84000000D+03	0.14000000D-04	0.15400000D-03
53	0.88000000D+03	0.95700000D-05	0.11300000D-03
54	0.92000000D+03	0.66100000D-05	0.84600000D-04
55	0.96000000D+03	0.46600000D-05	0.63500000D-04
56	0.10000000D+04	0.34600000D-05	0.48800000D-04

* END OF GIDS WORKING ATMOSPHERIC DENSITY FILE REPORT *

Figure H-46. Working Atmospheric Density File Report

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STATION GEODETICS FILE REPORT

INDEX - STATION GEODETICS FILE REPORT

STATION ACRONYM	INDEX NUMBER	TYPE	SPHERICAL COORDINATES (DEG MN SEC)	CARTESIAN COORD (KM)		REF ELLIP NO.
[illegible]	40200	LASER	GEODETIC LAT. = 38 [illegible] GEOGRAPHIC LONG= 283 [illegible] HEIGHT = [illegible] METERS	X= 1130.72238 Y= -4831.37181 Z= 3994.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= 0.0 KM TRANS. FREQ. = [illegible]	1
[illegible]	22100	LASER	GEODETIC LAT. = 41 36 [illegible] GEOGRAPHIC LONG= 246 [illegible] HEIGHT = 1966.900 METERS	X= -1735.[illegible] Y= -4425.[illegible] Z= 4241.43783	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= 0.0 KM TRANS. FREQ. = [illegible]	1
[illegible]	22200	LASER	GEODETIC LAT. = 39 58 26.[illegible] GEOGRAPHIC LONG= 239 3 38.2100 HEIGHT = 1834.600 METERS	X= -2816.[illegible] Y= -4100.[illegible] Z= 4076.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= 0.0 KM TRANS. FREQ. = [illegible]	1
[illegible]	22300	LASER	GEODETIC LAT. = 32 36 [illegible] GEOGRAPHIC LONG= 243 [illegible] HEIGHT = 960.000 METERS	X= -2428.[illegible] Y= -4799.[illegible] Z= 3417.27900	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= 0.0 KM TRANS. FREQ. = [illegible]	1
GESA	2	USBRS	GEODETIC LAT. = 35 20 29.[illegible] GEOGRAPHIC LONG= 243 7 37.2100 HEIGHT = 913.310 METERS	X= -2356.[illegible] Y= -4646.[illegible] Z= 3669.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1
[illegible]	3	USBRS	GEODETIC LAT. = 35 20 29.[illegible] GEOGRAPHIC LONG= 243 7 35.0420 HEIGHT = 918.710 METERS	X= -2356.[illegible] Y= -4646.[illegible] Z= 3669.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1
[illegible]	43	C-BAND	GEODETIC LAT. = 32 20 [illegible] GEOGRAPHIC LONG= 295 [illegible] HEIGHT = -36.[illegible] METERS	X= 2308.[illegible] Y= -4873.[illegible] Z= 3393.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= 0.0 KM TRANS. FREQ. = [illegible]	1
[illegible]	33	USB30	GEODETIC LAT. = 35 [illegible] GEOGRAPHIC LONG= 277 [illegible] HEIGHT = 810.360 METERS	X= 447.[illegible] Y= -5170.[illegible] Z= 3656.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1
[illegible]	16	USB30	GEODETIC LAT. = 28 30 29.[illegible] GEOGRAPHIC LONG= 279 [illegible] HEIGHT = -54.[illegible] METERS	X= 907.[illegible] Y= -5636.[illegible] Z= 3026.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1
[illegible]	33	USB30	GEODETIC LAT. = -35-37-[illegible] GEOGRAPHIC LONG= 148 [illegible] HEIGHT = 924.200 METERS	X= -4447.[illegible] Y= 2676.[illegible] Z= -3698.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1
[illegible]	4	USBRS	GEODETIC LAT. = 40 27 [illegible] GEOGRAPHIC LONG= 355 [illegible] HEIGHT = 800.000 METERS	X= 4847.[illegible] Y= -353.[illegible] Z= 4117.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1
[illegible]	15	USB30	GEODETIC LAT. = 22 7 34.[illegible] GEOGRAPHIC LONG= 200 20 5.4300 HEIGHT = 1134.760 METERS	X= -5543.[illegible] Y= -2054.[illegible] Z= 2387.[illegible]	N-S VERT DEFL = 0.0 MAD E-W VERT DEFL = 0.0 MAD ANTENNA OFFSET= [illegible] KM TRANS. FREQ. = [illegible]	1

DESCRIPTION OF REFERENCED ELLIPSOIDS

NUMBER	SMA IN KM	1/F	NUMBER	SMA IN KM	1/F
1	6378.166000	298.300000	4	0.0	1.003333
2	0.0	1.000000	5	0.0	1.003333
3	0.0	1.000000			

******** ******** ******** ******** END OF GIDS STATION GEODETICS WORKING FILE REPORT ******** ******** ******** ********

Figure H-47. Station Geodetics Working File Report

- Antenna offset
- Transmission frequency

The referenced ellipsoid models are given by number and an associated semimajor axis and inverse of flattening coefficient.

H.9.3 ELEMENTS WORKING FILE REPORT

When the user specifies the option to build an elements working file via the WORKELS keyword card, the Elements Working File Report (Figure H-48) is generated. The information contained in this report includes the following:

- Epoch for the elements (year, month, day, hours, minutes, and seconds)
- Central body
- Referenced time frame (either true-of-date or mean-of-1950.0)
- Cartesian coordinates (position and velocity)

H.9.4 INTEGRATION COEFFICIENTS WORKING FILE REPORT

This report is generated when the option to build a working file of integration coefficients has been specified by the user. The following information is given in this report:

- Predictor coefficients for position
- Corrector coefficients for position
- Corrector coefficients for the position partial derivatives
- Predictor coefficients for velocity
- Corrector coefficients for velocity
- Corrector coefficients for velocity partial derivatives

```
                                   WORKING ELEMENTS FILE REPORT                                  PAGE 6
EPOCH  OCT [illegible], [illegible], 17 HRS. 30 MIN.   0.0   SEC.
  EARTH CENTERED
REFERENCED TO  TRUE OF DATE
CARTESIAN COORDINATES
                    X  [illegible]      KM      Y  [illegible]      KM      Z  [illegible]      KM
                   DX  [illegible]      KM/S   DY  [illegible]      KM/S   DZ  [illegible]      KM/S
* * * * * * * * * * * * * * * * * * * *END OF GIDS WORKING ELEMENTS FILE REPORT* * * * * * * * * * * * * * * * * * * * * * * *
```

Figure H-48. Elements Working File Report

- Order of the integration formulas for each of the preceding six categories
- Error coefficients (local error computation for C1 and C2, see CWEIGHT card in Section 4).

An example of this report is shown in Figure H-49.

H.9.5 REFRACTION WORKING FILE REPORT

Contained in the Refraction Working File Report are reports of three files:

- Solar Flux Data File
- Ionospheric coefficients working file
- Refraction table working data file (only in the case of a real-time run)

Only a description of each file is given, not the complete contents of the file. The report for the Solar Flux Data File contains the following:

- The number of months for which the file is valid
- The first and last month contained in the file
- The date of the most recent daily solar flux values
- The date beyond which the solar flux values are predicted
- The timespan for the predicted values on the file
- The 12-month running average of solar flux
- The 12-month span (maximum and minimum values) on the file

The contents of the ionospheric coefficients working file include the number of 10-day coefficient sets contained in the file and the total time covered by those sets. The report of the ionospheric (real-time) refraction tables working data file gives the number of days in the file, the

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****** ********** WORKING FILE REPORT ********** ******
INTEGRATION COEFFICIENTS WORKING FILE

POSITION PREDICTOR COEFF.	CORRECTOR COEFF.	CORRECTOR COEFF. FOR PARTIALS	VELOCITY PREDICTOR COEFF.	CORRECTOR COEFF.	CORRECTOR COEFF. FOR VELOCITY PARTIALS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER= 8	ORDER= 8	ORDER= 8	ORDER= 8	ORDER= 8	ORDER= 8

ERROR COEFF - LOCAL ERROR COMPUTATION (1) [illegible]
ERROR COEFF - LOCAL ERROR COMPUTATION (2) [illegible]

********** ********** ********** END OF WORKING FILE REPORT ********** ********** **********

Figure II-49. Integration Coefficients Working File Report

first day of the file, and the last day of the file. The Refraction Working File Report appears after the SLP Ephemeris Working File Report; an example is given in Figure H-52.

H.9.6 IMPULSIVE MANEUVERS WORKING FILE REPORT

The Impulsive Maneuvers Working File Report (no example given) gives the total number of maneuvers occurring in the flight (to a maximum of five) and the time period covering those maneuvers. For each maneuver, the following information is given:

- Maneuver number
- Maneuver time (in seconds from epoch)
- Velocity component increments in kilometers per second
- Vehicle mass before the maneuver
- Vehicle mass after the maneuver
- Change in mass caused by the maneuver
- Coordinate system of the maneuver (1 implies 1950.0 and 2 implies true-of-date)

H.9.7 FLIGHT SECTIONING WORKING FILE REPORT

This report contains the following information: the number of sections scheduled, the section crossover conditions, the integration model values, and the section-dependent indicators and flags. The total number of sections scheduled is first given. Included in the section crossover conditions are the section number, the time into flight, the cause of crossover, and the crossover tolerances. The integration model values given include the integration mode, the initial step size, and the upper, lower, and nominal truncation error bounds. Finally, the section-dependent indicators and flags include the central body, the noncentral bodies, the integration step mode, the coordinate system type, the

reference coordinate system, and the type of integration restart. Also given are indicators as to whether specific conditions (such as drag, two-body motion, polar motion, and solar radiation pressure) have been specified and whether special output has been requested. An example of this report is shown in Figure H-50.

H.9.8 PHYSICAL CONSTANTS WORKING FILE REPORT

In a Data Management Program run, a full report of the physical constants working file will be generated. Included in this report (see Figure H-51) are the following:

- Universal gravitational constant (km^3/sec^2 gm)
- Gravitational constant times mass for each body requested (km^3/sec^2)
- Mean equatorial radius in kilometers for each body requested
- Rotation rate in radians per second for each body requested
- Sphere of influence in kilometers for each body requested
- Inverse flattening coefficient for each body requested
- Greenwich Hour Angle at epoch for each body

When the harmonics for the Earth or Moon are reported, the information given includes the name of the body, the maximum degree and maximum order of the coefficients, and values for the zonal, sectoral, and tesseral harmonics.

Much of the information contained in this report is also contained in the various Initial Conditions Reports.

```
                                   GTDS  DATAMGT  PROGRAM                                        PAGE    7

            ******     **********    WORKING FILE REPORT    **********    ******
                                   SECTIONING WORKING FILE

                              TOTAL NUMBER OF SECTIONS SCHEDULED  =    2

                   **********      SECTION CROSSOVER CONDITIONS      **********

                      SECTION            1                    2
TIME OF FLIGHT (SEC FROM EPOCH)   0.0                  0.0
DISTANCE FROM CB (KM)             0.25000000000D+06    0.0
DETERMINED BY RCA                      NO                   NO
DISTANCE FROM NEXT CB AT CROSS    0.0                  0.0
DETERMINED BY RCA TO NEXT CB           NO                   NO
DET. BY SPHERE OF INFLUENCE            NO                   NO

                   **********      INTEGRATION MODEL VALUES      **********

                      SECTION            1                    2
INTEGRATION MODE                  REGULAR VARY         REGULAR VARY
STEPSIZES FOR FIXED STEP
UPPER TRUNCATION ERROR BOUND      0.25000000000D-07    0.25000000000D-07
LOWER TRUNCATION ERROR BOUND      0.25000000000D-13    0.25000000000D-13
NOMINAL TRUNCATION ERROR BOUND    0.25000000000D-10    0.25000000000D-10

                   ********** SECTION DEPENDENT INDICATORS AND FLAGS **********

                      SECTION            1                    2
CENTRAL BODY                           EARTH                MOON
NON-CENTRAL BODY  1                     NONE                 NONE
NON-CENTRAL BODY  2                     NONE                 NONE
INTEGRATION STEP MODE               REGULAR VARY         REGULAR VARY
TWO-BODY MOTION                         YES                  YES
POLAR MOTION                            NO                   NO
SOLAR RADIATION PRESSURE                NO                   NO
DRAG                                    NO                   NO
HARMONICS                               NONE                 NONE
MAX ORDER FOR EARTH-MOON
    FIELDS VARIATIONAL EQNS
MAX DEGREE FOR EARTH-MOON
    VARIATIONAL EQNS
MAX ORDER FOR EARTH-MOON
    EQNS OF MOTION
MAX DEGREE FOR EARTH-MOON
    EQNS OF MOTION
GEOCENTRIC OUTPUT REQUESTED             YES                  YES
HELIOCENTRIC OUTPUT REQUESTED           YES                  YES
TARGET BODY OUTPUT REQUESTED            YES                  YES
COORDINATE SYSTEM TYPE            CART,KEPLR,SPHER     CART,KEPLR,SPHER
REFERENCE COORDINATE SYSTEM         TRUE OF DATE         TRUE OF DATE
                                      INERTIAL             INERTIAL
PARTIALS OUTPUT                         YES                  YES
TYPE OF INTEGRATION RESTART          MUL-STEP             MUL-STEP
RCA TO CENTRAL BODY SWITCH              NO                   NO
RCA TO NEXT CENTRAL BODY SWITCH         NO                   NO

     **********   **********   ********** END OF WORKING FILE REPORT **********   **********   **********
```

Figure H-50. Flight Sectioning Working File Report

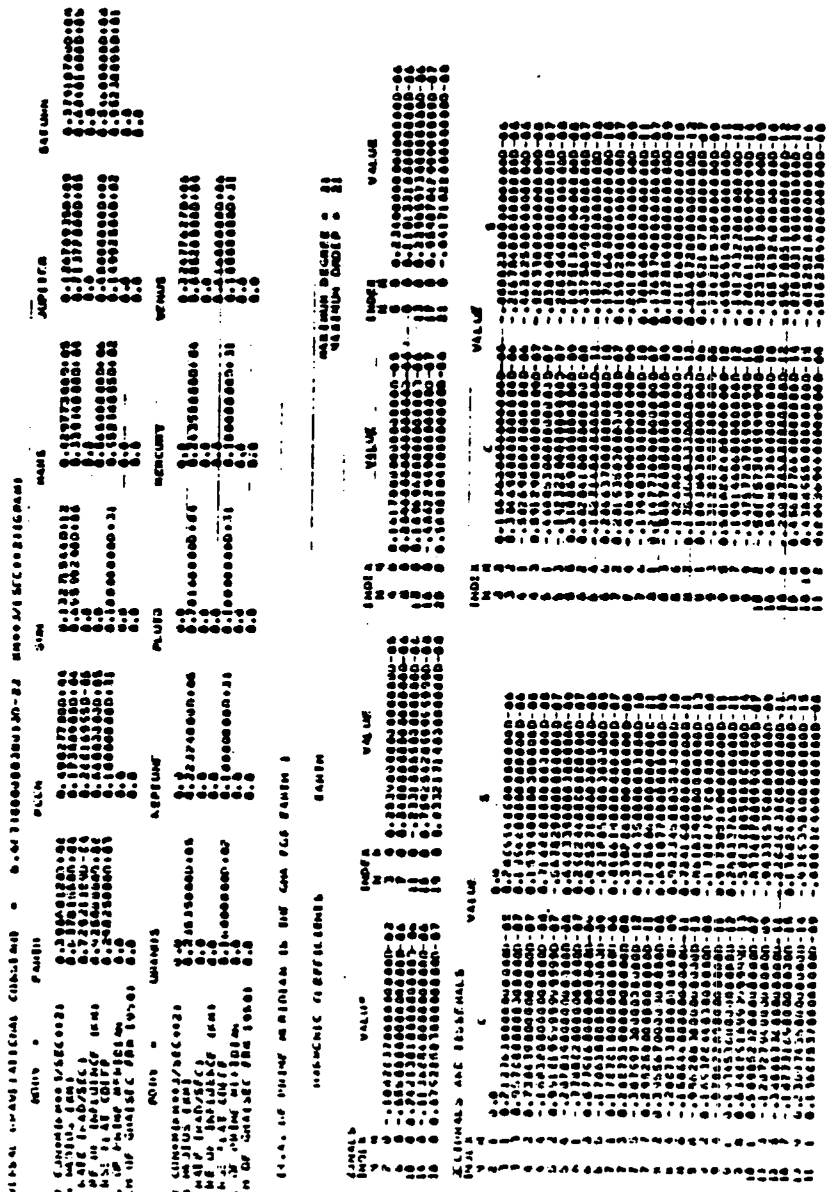

Figure H-51. Physical Constants Working File Report (1 of 3)

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WORKING FILE REPORT - PHYSICAL CONSTANTS WORKING FILE

INDEX N	INDEX M	VALUE C	VALUE S	INDEX N	INDEX M	VALUE C	VALUE S
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-51. Physical Constants Working File Report (2 of 3)

GIDL DC PHIGMAN PAGE [illegible]

WORKING FILE REPORT - PHYSICAL CONSTANTS WORKING FILE

INDEX N	INDEX M	VALUE C	VALUE S	INDEX N	INDEX M	VALUE C	VALUE S
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.0	0.0	[illegible]	[illegible]	0.0	0.0

********** ********** ********** END OF WORKING FILE REPORT ********** ********** **********

Figure H-51. Physical Constants Working File Report (3 of 3)

H.9.9 SOLAR/LUNAR/PLANETARY (SLP) EPHEMERIS WORKING FILE REPORT

When the SLP Ephemeris Working File Report (Figure H-52) is generated for a Data Management Program run, only a summary report is given. The information reported includes the following:

- Date of report
- Start time of SLP data
- Number of days of data
- End time of data
- Total number of bodies represented by curve-fits
- Corresponding central body, fast body, and slow bodies
- Degrees of polynomials for rotation matrix
- Degrees of polynomials for fast-body position
- Degrees of polynomials for fast-body velocity
- Degrees of polynomials for slow-body position
- Number of days per curve-fit
- Coordinate system reference

H.9.10 REJECTED STATIONS REPORT

The Rejected Stations Report appears during the input processor interpretation of the input card deck. This report, which is printed after the DMOPT subdeck has been interpreted, lists the stations rejected, the number of observations associated with each of the rejected stations, the index number, and the reason for rejecting the station. An example of this report is given in Figure H-53.

```
              GIDS OC        PROGRAM                                              PAGE   19
        GIDS SLP EPHEMERIS   SUMMARY REPORT
                          INDEX - SLP EPHEMERIS   SUMMARY REPORT

DATE OF REPORT IS OCT  22,1981
START TIME OF DATA                                    = JAN   1,1978
NUMBER OF DAYS OF DATA                                =   3980
FINAL TIME OF DATA                                    = NOV  20,1988
NUMBER OF BODIES REPRESENTED BY CURVE-FITS            =  9
CENTRAL BODY FOR POLYNOMIAL COEFFICIENTS              = EARTH
FAST BODY FOR POLYNOMIAL COEFFICIENTS                 = MOON
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = SUN
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = MARS
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = JUPITER
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = SATURN
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = URANUS
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = MERCURY
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS               = VENUS
DEGREE OF POLYNOMIALS FOR ROTATIONMATRIX              =   9
DEGREE OF POLYNOMIALS FOR FAST BODY POSITION          =  10
DEGREE OF POLYNOMIALS FOR FAST BODY VELOCITY          =  12
DEGREE OF POLYNOMIALS FOR SLOW BODY POSITION          =   9
NUMBER OF DAYS PER CURVE FIT                          =  30
COORDINATE SYSTEM REFERENCED TO TRUE OF DATE
**********************************************************************************************
                          CONTENTS OF SOLAR DATA PERMANENT FILE

   MONTHS FOR WHICH FILE IS VALID -- FIRST =  1/70, LAST =  1/82
   MOST RECENT DAILY SOLAR FLUX VALUES --      8/81  -- FILE CONTAINS PREDICTED VALUES BEYOND THIS DATE
   12-MONTH RUNNING AVERAGE OF SOLAR FLUX --  1/70 THRU  2/81  -- FINAL VALUES
                                          --  3/81 THRU  1/82  -- PREDICTED VALUES
**********************************************************************************************
                          CONTENTS OF IONOSPHERIC COEFFICIENTS WORKING FILE

   NUMBER OF 10-DAY COEFFICIENT SETS:     1
    TOTAL TIME SPANNED BY THESE SETS:   1/11/76 THRU 10/11/76
**********************************************************************************************
```

Figure II-52. Solar/Lunar/Planetary Ephemeris Working File Report and Refraction Working File Report

NUMBER OF OBSERVATIONS	STATION NAME	INDEX NUMBER	REASON FOR REJECTION
1		[illegible]	NO STATION NAME FOUND UNDER INDEX NUMBER
8234	UH3K	163	MORE THAN 20 ACCEPTED STATIONS IN RUN
5468	UH2K	142	MORE THAN 20 ACCEPTED STATIONS IN RUN
749		467	NO STATION NAME FOUND UNDER INDEX NUMBER
358	UHBJ	481	MORE THAN 20 ACCEPTED STATIONS IN RUN
37		425	NO STATION NAME FOUND UNDER INDEX NUMBER
114	ORAJ	410	MORE THAN 20 ACCEPTED STATIONS IN RUN
16		423	NO STATION NAME FOUND UNDER INDEX NUMBER
156	ACAJ	407	MORE THAN 20 ACCEPTED STATIONS IN RUN

Figure H-53. Rejected Stations Report

H.9.11 DETAILED ACCEPT/REJECT CRITERIA

The Detailed Accept/Reject Criteria Report also appears after the input processor interpretation of the DMOPT deck; it summarizes and interprets the edit cards in that sub-deck. Two examples of the report are shown in Figure H-54: one summarizes the reject criteria, the other summarizes the accept criteria. The reports list observation timespan, station, object number, ground transponder, GTDS types, mode, rate, and edit frequency.

H.10 PERMANENT FILE REPORT GENERATION (FILERPT) PROGRAM OUTPUT

The Permanent File Report Generation Program generates user-specified reports of data resident on the following permanent files:

- Astrodynamic (Physical) Constants File
- Atmospheric Density Models File
- Earth Potential Fields File
- Flight Sectioning Models File
- GTDS Permanent Elements File
- Integration Coefficients File
- Lunar Potential Fields File
- Solar/Lunar/Planetary (SLP) Ephemeris File
- Tracking Station Geodetics File
- 24-Hour Hold Elements File
- Permanent Maneuvers File

The reports generated depend on the requested files and the level of detail requested. The following sections present an overview of the reports available for the various files.

H.10.1 ASTRODYNAMIC (PHYSICAL) CONSTANTS FILE REPORTS

The Astrodynamic Constants File contains sets (models) of constants associated with the Sun, the Moon, and the planets. A full report of the file, as shown in

GIDS DC PROGRAM PAGE [illegible]

GIDS DATA MANAGEMENT REPORT

DETAILED ACCEPT/REJECT CRITERIA

OBSERVATION TIME SPAN	STATIONS	OBJ.NO.	[illegible]	GIDS TYPES	MODE	RATE	EDIT FREQ.
ACCEPT:							
750228 000000. - 790103 000000.	(ALL)	(ALL)	(ALL)	SVR JHAN JRAN	(ALL)	(ALL)	EVERY ONE
750228 000000. - 790103 000000.	(ALL)	(ALL)	(ALL)	SVRN UNDF UNDF	(ALL)	(ALL)	EVERY ONE
750228 000000. - 790103 000000.	(ALL)	(ALL)	(ALL)	TD2G	(ALL)	(ALL)	EVERY ONE
750228 000000. - 790103 000000.	(ALL)	(ALL)	(ALL)	ED2G	(ALL)	(ALL)	EVERY ONE
750228 000000. - 790103 000000.	(ALL)	(ALL)	(ALL)	TD1S	(ALL)	(ALL)	EVERY ONE
750228 000000. - 790103 000000.	(ALL)	(ALL)	(ALL)	TDHG	(ALL)	(ALL)	EVERY ONE
[illegible]	(ALL)	(ALL)	(ALL)	[illegible]	(ALL)	(ALL)	EVERY ONE
REJECT:							
761101 000000. - 761103 000000.	FIC3	(ALL)	(ALL)	(ALL)	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	DI23	(ALL)	(ALL)	(ALL)	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	BCA1	(ALL)	(ALL)	(ALL)	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	ACN3	(ALL)	(ALL)	(ALL)	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	ULA3	(ALL)	(ALL)	(ALL)	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	GSP3	(ALL)	(ALL)	(ALL)	(ALL)	(ALL)	EVERY ONE
[illegible]	[illegible]	(ALL)	(ALL)	SVRO UN30 [illegible]	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	RCSS	(ALL)	(ALL)	SVRO UN30 [illegible]	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	JUIS	(ALL)	(ALL)	SVRO UN30 [illegible]	(ALL)	(ALL)	EVERY ONE
761101 000000. - 761103 000000.	CUIS	(ALL)	(ALL)	SVRO CR30 [illegible]	(ALL)	(ALL)	EVERY ONE

* SOME GIDS TYPES ARE NOT UNIQUELY DETERMINED BY GIDS TYPE NUMBER

Figure H-54. Detailed Accept/Reject Criteria Report

Figure H-55, can be requested via keyword CONSTRPT to obtain the total number of models on the file and the data content of the file for each model. The data printed for each body includes the gravitational constant times the mass, the mean radius, the rotation rate, the radius of the sphere of influence, the inverse flattening coefficient, the right ascension of the prime meridian, and the epoch of the Greenwich Hour Angle.

Subsets of this report, such as a specific model or a specific body in a given model, as well as a summary of the file that includes only text descriptions of the models in the file, are also obtained via CONSTRPT (see Figure H-56).

H.10.2 ATMOSPHERIC DENSITY MODELS FILE REPORTS

The Atmospheric Density Models File contains tables of Harris-Priester density values associated with various solar flux values. Each table is considered a model. The reports available through keyword card ATMOSRPT include a summary report of the file and a report of a specific model on the file. The summary report (Figure H-57) gives text descriptions of all models in the file. The specific model report (as shown in Figure H-58) provides a table of altitude-versus-density ranges.

H.10.3 EARTH POTENTIAL FIELDS FILE REPORTS

The Earth Potential Fields File contains sets (models) of harmonic coefficients defining the Earth's gravity field. A full report of the file contains the total number of models on the file and the data content for each model. The data printed include order and degree of the field, zonal, sectoral, and tesseral values, and constants employed in the derivation of the data. Model number 1 from the full report is shown in Figure H-59. A subset of this report containing data for only one model can also be obtained. In addition,

```
                         GTDS  FILEAPT  PROGRAM
        ******  **********  PERMANENT FILE REPORT  **********  ******
                     PHYSICAL CONSTANTS PERMANENT FILE
                               FULL REPORT

 THE TOTAL NUMBER OF ASTRONOMICAL CONSTANTS MODELS ON THE FILE IS    1

 THE PERMANENT ASTRONOMICAL CONSTANTS FILE HAS ROOM FOR        8 MODELS

            ***** PERMANENT ASTRONOMICAL CONSTANTS FILE *****

          MODEL NUMBER          MODEL DESCRIPTION
               1

UNIVERSAL GRAVITATIONAL CONSTANT  =  0.[illegible]D-22  KM**3/(SEC**2)(GRAM)
```

BODY =	EARTH	MOON	SUN	MARS	JUPITER	SATURN
GRAV CONST(KM**3/SEC**2)	0.39860320D+06	0.49027790D+04	0.13271244D+12	0.42977[illegible]D+05	0.12670[illegible]D+09	0.37918700D+08
MEAN RADIUS (KM)	0.63781650D+04	0.17380000D+04	0.69599200D+06	0.33934000D+04	0.71372000D+05	0.60401000D+05
ROT RATE (RAD/SEC)	0.7292[illegible]D-04	0.266[illegible]D-05	0.0	0.0	0.0	0.0
SPHERE OF INFLUENCE (KM)	0.92500000D+06	0.66000000D+05	0.0	0.58000000D+06	0.48000000D+08	0.54000000D+08
INVERSE FLAT COEFF	0.29825000D+03	0.10000000D+31	0.10000000D+31	0.[illegible]D+03	0.1592[illegible]D+02	0.[illegible]D+00
R.A. OF PRIME MERIDIAN	0.0	0.0	0.0	0.0	0.0	0.0
EPOCH OF GHA(SEC FRM 1950)	0.0	0.0	0.0	0.0	0.0	0.0

```
UNIVERSAL GRAVITATIONAL CONSTANT  =  0.[illegible]D-22  KM**3/(SEC**2)(GRAM)
```

BODY =	URANUS	NEPTUNE	PLUTO	MERCURY	VENUS
GRAV CONST(KM**3/SEC**2)	0.0	0.0	0.0	0.0	0.32487[illegible]
MEAN RADIUS (KM)	0.2353[illegible]D+05	0.22324000D+05	0.[illegible]D+04	0.[illegible]D+04	[illegible]
ROT RATE (RAD/SEC)	0.0	0.0	0.0	0.0	0.0
SPHERE OF INFLUENCE (KM)	0.0	0.0	0.0	0.0	0.61600000D+06
INVERSE FLAT COEFF	0.16000000D+02	0.10000000D+31	0.10000000D+31	0.10000000D+31	0.10000000D+31
R.A. OF PRIME MERIDIAN	0.0	0.0	0.0	0.0	0.0
EPOCH OF GHA(SEC FRM 1950)	0.0	0.0	0.0	0.0	0.0

```
      (R.A. OF PRIME MERIDIAN IS THE GHA FOR EARTH )

 **********  **********  **********  END OF PERMANENT FILE REPORT  **********  **********  **********
```

Figure H-55. Astrodynamic Constants File Full Report

DOC. NO. REV. NO.
SD-85/6738 2

```
                    [illegible]
  ******     **********   PERMANENT FILE REPORT   **********    ******
                    [illegible] CONSTANTS PERMANENT FILE
                            SUMMARY REPORT
------------------------------------------------------------------------
THE TOTAL NUMBER OF ASTRONOMICAL CONSTANTS MODELS ON THE FILE IS   [illegible]

THE PERMANENT ASTRONOMICAL CONSTANTS FILE HAS [illegible]         [illegible] MODELS
------------------------------***** PERMANENT ASTRONOMICAL CONSTANTS FILE *****---------

        MODEL NUMBER        MODEL DESCRIPTION
             [illegible]
------------------------------------------------------------------------
**********   **********   ********** END OF PERMANENT FILE REPORT **********   **********   **********
```

Figure H-56. Astrodynamic Constants File Summary Report

149

```
                         GTDS  FILEAFT  PROGRAM
      DATA MANAGEMENT REPORT OF THE PERMANENT FILES  -- ATMOSPHERIC DENSITY

          **********JACCHIA-ROBERTS ATMOSPHERIC DENSITY FILE REPORT************

     FIRST DAY OF DATA ON JACCHIA PERMANENT FILE                         =  NOV 22,1973
     LAST  DAY OF DATE ON JACCHIA PERMANENT FILE                         =  JULY 3,1987
     LAST  DAY OF MEASURED SOLAR FLUX AND KP NUMBERS                     =  JAN 31,1981
     LAST  DAY OF USING MEASURED SOLAR FLUX ONLY TO COMPUTE EXOSPHERIC TEMPERATURE=  DEC 22,1980
     NOTE THAT THE 27 DAYS PRIOR TO FINAL DATE OF MEASURED SOLAR FLUX (IE. JAN 5,
     1981THRU JAN 31,1981) ARE EXTRAPOLATED TO COMPUTE EXOSPHERIC TEMPERATURE TO
     THE END OF THE PERMANENT FILE (IE. THRU JULY 3,1987)
MODEL NUMBER:   1
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0050

MODEL NUMBER:   2
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0075

MODEL NUMBER:   3
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0100

MODEL NUMBER:   4
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0125

MODEL NUMBER:   5
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0150

MODEL NUMBER:   6
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0175

MODEL NUMBER:   7
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0200

MODEL NUMBER:   8
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0225

MODEL NUMBER:   9
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0250

MODEL NUMBER:  10
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
          1964 HARRIS/PRIESTER ATMOSPHERE 30 IN-DAYS 0-1000 KM  F0275
```

Figure H-57. Atmospheric Density Models File Summary Report

GTDS FILEDPT PROGRAM

DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- ATMOSPHERIC DENSITY

MODEL NUMBER: 1
NUMBER OF ENTRIES IN DENSITY ARRAY: 56
MODEL NAME:
[illegible] HARRIS/PRIESTER ATMOSPHERE [illegible] 6-1360 KM [illegible]

ATMOSPHERIC DENSITY MODEL

ALTITUDE (IN KM)	MINIMUM DENSITY (IN KG/M**3)	MAXIMUM DENSITY (IN KG/M**3)
0.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

END OF PERMANENT ATMOSPHERIC DENSITY REPORT

Figure H-58. Atmospheric Density Specific Model Report (1 of 2)

GTDS FILEPRT PROGRAM

DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- ATMOSPHERIC DENSITY

MODEL NUMBER: 2
NUMBER OF ENTRIES IN DENSITY ARRAYS 56
MODEL NAME:
1964 HARRIS/PRIESTER ATMOSPHERE [illegible] 0-1000 KM F075

ATMOSPHERIC DENSITY MODEL

ALTITUDE (IN KM)	MINIMUM DENSITY (IN KG/KM**3)	MAXIMUM DENSITY (IN KG/KM**3)
0.0	1.2250000D+09	1.2250000D+09
2.0000000D+01	8.8910000D+07	8.8910000D+07
4.0000000D+01	3.9957000D+06	3.9957000D+06
6.0000000D+01	3.0592000D+05	3.0592000D+05
8.0000000D+01	1.9990000D+04	1.9990000D+04
1.0000000D+02	4.9740000D+02	4.9740000D+02
1.1000000D+02	7.8000000D+01	7.8000000D+01
1.2000000D+02	2.4500000D+01	2.4530000D+01
1.3000000D+02	8.9130000D+00	9.2830000D+00
1.4000000D+02	4.0510000D+00	4.1570000D+00
1.5000000D+02	1.3920000D+00	2.1760000D+00
1.6000000D+02	8.1600000D-01	1.2490000D+00
1.7000000D+02	5.7810000D-01	7.6470000D-01
1.8000000D+02	4.1873000D-01	5.0160000D-01
1.9000000D+02	3.0230000D-01	3.3910000D-01
2.0000000D+02	1.7250000D-01	2.3010000D-01
2.1000000D+02	1.1510000D-01	1.7160000D-01
2.2000000D+02	7.8443000D-02	1.2420000D-01
2.3000000D+02	5.4850000D-02	9.4353000D-02
2.4000000D+02	3.8549000D-02	7.1860000D-02
2.5000000D+02	2.8153000D-02	5.4925000D-02
2.6000000D+02	2.3563000D-02	4.2613000D-02
2.7000000D+02	1.5230000D-02	3.3370000D-02
2.8000000D+02	1.1610000D-02	2.6350000D-02
2.9000000D+02	8.8310300D-03	2.0940000D-02
3.0000000D+02	6.6443600D-03	1.6630000D-02
3.2000000D+02	3.6441000D-03	1.1130000D-02
3.4000000D+02	2.3610000D-03	7.6140000D-03
3.6000000D+02	1.4030000D-03	5.1800000D-03
3.8000000D+02	8.6840000D-04	3.5570000D-03
4.0000000D+02	5.4910000D-04	2.5340000D-03
4.2000000D+02	3.4150000D-04	1.7600000D-03
4.4000000D+02	2.1250000D-04	1.2510000D-03
4.6000000D+02	1.4180000D-04	8.3380000D-04
4.8000000D+02	9.3340000D-05	6.7953000D-04
5.0000000D+02	6.1540000D-05	4.5760000D-04
5.2000000D+02	4.1950000D-05	3.0460000D-04
5.4000000D+02	2.8590000D-05	2.7130000D-04
5.6000000D+02	1.9550000D-05	2.1950000D-04
5.8000000D+02	1.4270000D-05	1.8110000D-04
6.0000000D+02	1.1650000D-05	1.1370000D-04
6.2000000D+02	8.5600000D-06	8.6160000D-05
6.4000000D+02	6.4550000D-06	6.5673000D-05
6.6000000D+02	5.4100000D-06	5.0430000D-05
6.8000000D+02	4.4150000D-06	3.9630000D-05
7.0000000D+02	3.7770000D-06	3.0470000D-05
7.2000000D+02	3.2380000D-06	2.4020000D-05
7.4000000D+02	2.8120000D-06	1.9130000D-05
7.6000000D+02	2.4660000D-06	1.5400000D-05
7.8000000D+02	2.1840000D-06	1.2500000D-05
8.0000000D+02	1.9453000D-06	1.0330000D-05
8.4000000D+02	1.6600000D-06	6.9010000D-06
8.8000000D+02	1.3600000D-06	4.8000000D-06
9.2000000D+02	1.1790000D-06	3.4590000D-06
9.6000000D+02	1.0200000D-06	2.5000000D-06
1.0000000D+03	9.3000000D-07	1.8500000D-06

END OF PERMANENT ATMOSPHERIC DENSITY REPORT

Figure H-58. Atmospheric Density Specific Model Report (2 of 2)

GIDS FILEPPI PROGRAM PAGE 6

PERMANENT FILE REPORT
PHYSICAL CONSTANTS PERMANENT FILE
FULL REPORT

THE TOTAL NUMBER OF EARTH POTENTIAL MODELS ON THE FILE IS 5

THE PERMANENT EARTH POTENTIAL FILE HAS ROOM FOR 6 MODELS

***** PERMANENT EARTH POTENTIAL FILE ****

MODEL NUMBER 1 — MODEL DESCRIPTION: UPDATE OF SAO 1969 STANDARD EARTH MODEL NO. 3

GRAV CONSTANT(KM**3/SEC**2) [illegible]
MEAN RADIUS(KM) [illegible]

HARMONIC COEFFICIENTS EARTH — MAXIMUM DEGREE = [illegible], MAXIMUM ORDER = [illegible]

ZONALS

INDEX N M	VALUE	INDEX N M	VALUE	INDEX N M	VALUE	INDEX N M	VALUE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

SECTORIALS AND TESSERALS

INDEX N M	VALUE C	VALUE S	INDEX N M	VALUE C	VALUE S
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-59. Earth Potential Fields File Report - Excerpt From the Full Report (1 of 2)

GTDS FILPRT PROGRAM PAGE 8

PERMANENT FILE REPORT - PHYSICAL CONSTANTS PERMANENT FILE

INDEX N	INDEX M	VALUE C	VALUE S
13	4	[illegible]	[illegible]
13	6	[illegible]	[illegible]
13	8	[illegible]	[illegible]
13	10	[illegible]	[illegible]
13	12	[illegible]	[illegible]
14	1	[illegible]	[illegible]
14	3	[illegible]	[illegible]
14	5	[illegible]	[illegible]
14	7	[illegible]	[illegible]
14	9	[illegible]	[illegible]
14	11	[illegible]	[illegible]
14	13	[illegible]	[illegible]
15	1	[illegible]	[illegible]
15	3	[illegible]	[illegible]
15	5	[illegible]	[illegible]
15	7	[illegible]	[illegible]
15	9	[illegible]	[illegible]
15	11	[illegible]	[illegible]
15	13	[illegible]	[illegible]
15	15	[illegible]	[illegible]

INDEX N	INDEX M	VALUE C	VALUE S
13	5	[illegible]	[illegible]
13	7	[illegible]	[illegible]
13	9	[illegible]	[illegible]
13	11	[illegible]	[illegible]
13	13	[illegible]	[illegible]
14	2	[illegible]	[illegible]
14	4	[illegible]	[illegible]
14	6	[illegible]	[illegible]
14	8	[illegible]	[illegible]
14	10	[illegible]	[illegible]
14	12	[illegible]	[illegible]
14	14	[illegible]	[illegible]
15	2	[illegible]	[illegible]
15	4	[illegible]	[illegible]
15	6	[illegible]	[illegible]
15	8	[illegible]	[illegible]
15	10	[illegible]	[illegible]
15	12	[illegible]	[illegible]
15	14	[illegible]	[illegible]

Figure H-59. Earth Potential Fields File Report - Excerpt From the Full Report (2 of 2)

a summary of the file, which includes only text descriptions of all models in the file, is available (see Figure H-60). The reports are controlled by keyword card EPOTRPT.

H.10.4 FLIGHT SECTIONING MODELS FILE REPORTS

The Flight Sectioning Models File contains sets of specifications for the sectioning capability in the GTDS integration process. Each set of specifications comprises a flight section model which includes the number of sections, the force model information for each section, and the conditions that control the termination of each section. A full report of the file provides the number of models in the file and a detailed breakdown of the data in each model (see Figure H-61 for one sectioning model from the full report). The data include section crossover conditions, integration model values for each section, and force model and print options for each section. A subset of this report that provides a single requested model is also available, as is a summary report of the file that provides a text description of each model and the number of sections in each model (see Figure H-62). Both reports are controlled by keyword card SECTRPT.

H.10.5 GTDS PERMANENT ELEMENTS FILE REPORTS

The Permanent Elements File of GTDS contains converged DC Program elements and related information, plus a directory for locating all element sets associated with a particular satellite. A report on the directory (Figure H-63) provides a summary of satellites represented on the file and the number of element sets associated with each satellite.

A summary report of all element sets for a given satellite within a given timespan can be obtained. This report (Figure H-64) contains the satellite identification number, the element set number, the epoch, the actual elements, and information from the DC Program run that generated the

```
                    [illegible]
 ******   **********   PERMANENT FILE REPORT   **********   ******
            PHYSICAL CONSTANTS PERMANENT FILE
                    SUMMARY REPORT
-----------------------------------------------------------------------
THE TOTAL NUMBER OF EARTH POTENTIAL MODELS IN THE FILE IS        5

THE PERMANENT EARTH POTENTIAL FILE HAS ROOM FOR                  6 MODELS
-----------------------------------------------------------------------
              ***** PERMANENT EARTH POTENTIAL FILE *****
   MODEL NUMBER        MODEL DESCRIPTION
        1              UPDATE OF SAO 1969 STANDARD EARTH MODEL NO. 1
        2              EARTH POTENTIAL FOR MANNED FLIGHT COMPUTATIONS
        3              GEOPOTENTIAL EARTH MODEL THREE (GEM-3)
        4              GEOPOTENTIAL EARTH MODEL SEVEN (GEM-7)
        5              GEOPOTENTIAL EARTH MODEL NINE (GEM-9)
-----------------------------------------------------------------------
 **********  **********  **********  END OF PERMANENT FILE REPORT **********  **********  **********
```

Figure H-60. Earth Potential Fields File Summary Report

```
                                   CTCS  FILENET  PROGRAM
            *****    **********    PERMANENT FILE REPORT    **********    *****
                                   FLIGHT SECTIONING PERMANENT FILE

THE TOTAL NUMBER OF FLIGHT SECTIONING MODELS ON THE FILE IS    6
THE PERMANENT FLIGHT SECTIONING FILE HAS BEEN RUN                  16 MODELS

        MODEL NUMBER              1
        TITLE                   CLUT (FIXED STEP-RESTART)
        NUMBER OF SECTIONS        2

                        **********     SECTION CROSSOVER CONDITIONS     **********

                     SECTION                  1                     2
TIME OF FLIGHT (SEC FROM EPOCH)     NOT APPLICABLE        NOT APPLICABLE
DISTANCE FROM CB (KM)               0.2530000000D+06      NOT APPLICABLE
DETERMINED BY RCA                         NO                    NO
DISTANCE FROM NEXT CB AT CROSS      NOT APPLICABLE        NOT APPLICABLE
DETERMINED BY RCA TO NEXT CB              NO                    NO
RET. BY SPHERE OF INFLUENCE               NO                    NO

                        **********     INTEGRATION MODEL VALUES     **********

                     SECTION                  1                     2
INTEGRATION MODE                       FIXED STEP            FIXED STEP
STEPSIZES FOR FIXED STEP            0.2400000000D+02      0.2
UPPER TRUNCATION ERROR BOUND        0.2500000000D-07      0.2500000000D-07
LOWER TRUNCATION ERROR BOUND        0.2500000000D-13      0.2500000000D-13
NOMINAL TRUNCATION ERROR BOUND      0.2500000000D-10      0.2500000000D-10

                        ********** SECTION DEPENDENT INDICATORS AND FLAGS **********

                     SECTION                  1                     2
CENTRAL BODY                             EARTH                 MOON
NON-CENTRAL BODY 1                        NONE                  NONE
NON-CENTRAL BODY 2                        NONE                  NONE
INTEGRATION STEP MODE                  FIXED STEP            FIXED STEP
TWO-BODY MOTION                            YES                   YES
POLAR MOTION                               NO                    NO
SOLAR RADIATION PRESSURE                   NO                    NO
DRAG                                       NO                    NO
HARMONICS                                 NONE                  NONE
MAX DEGREE FOR EARTH-MOON
   VARIATIONAL EQNS                         0                     0
MAX ORDER FOR EARTH-MOON
   FIELDS VARIATIONAL EQNS                  0                     0
MAX DEGREE FOR EARTH-MOON
   EQNS OF MOTION                           0                     0
MAX ORDER FOR EARTH-MOON
   EQNS OF MOTION                           0                     0
SELENOCENTRIC OUTPUT REQUESTED
GEOCENTRIC OUTPUT REQUESTED                YES                   YES
HELIOCENTRIC OUTPUT REQUESTED              YES                   YES
TARGET BODY OUTPUT REQUESTED               YES                   YES
COORDINATE SYSTEM TYPE              CART,KEPLR,SPHER      CART,KEPLR,SPHER
REFERENCE COORDINATE SYSTEM           TRUE OF DATE          TRUE OF DATE
                                        INERTIAL              INERTIAL
PARTIALS OUTPUT                            YES                   YES
TYPE OF INTEGRATION RESTART              RUN-KUTT              RUN-KUTT
```

Figure H-61. Flight Sectioning Models File Full Report (One Model)

```
                         GTDS   FILEFFI   PROGRAM                                      PAGE    14
          *****    **********    PERMANENT FILE REPORT    **********    *****
                         FLIGHT SECTIONING PERMANENT FILE

THE TOTAL NUMBER OF FLIGHT SECTIONING MODELS ON THE FILE IS    6 MODELS
THE PERMANENT FLIGHT SECTIONING FILE HAS BEEN PCR

                         SUMMARY OF FLIGHT SECTIONING MODELS
   MODEL NUMBER                         TITLE                                   NUMBER OF SECTIONS

        1          GEOS (FIXED STEP-RSTART)                                           [illegible]
        2          IMP-6,BACKWARDS IMP-6,APOLLO (2 SECTIONS),MANEUVER ABOUT MOON      [illegible]
        3          DRAG                                                               [illegible]
        4          HARMONICS                                                          [illegible]
        5          SOLAR RADIATION                                                    [illegible]
        6        FULL FORCE                                                           [illegible]

 **********   **********   ********** END OF PERMANENT FILE REPORT **********   **********   **********
```

Figure H-62.   Flight Sectioning Models File Summary Report

```
                    GTDS FILERPT PROGRAM
  DATA MANAGEMENT REPORT OF THE PERMANENT FILES  -- PERMANENT ELEMENTS

        GENERAL REPORT OF PERMANENT ELEMENTS DIRECTORY

        NUMBER OF SATELLITES SUPPORTED    16
        PERMANENT ELEMENTS FILE IS 16 PERCENT FULL

        SAT ID = 7602901
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        3

        SAT ID = 6611301
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE       10

        SAT ID = 7613701
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        2

        SAT ID = 7009201
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE       11

        SAT ID = 7407701
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE       10

        SAT ID = 7507301
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        5

        SAT ID = 7701401
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        3

        SAT ID = 7006701
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        9

        SAT ID = 7612901
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        7

        SAT ID = 7707801
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        2

        SAT ID = 7205801
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        2

        SAT ID = 7219101
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        1

        SAT ID = 7590101
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        3

        SAT ID = 7550301
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        3

        SAT ID = 7602701
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        6

        SAT ID = 7560701
        NUMBER OF ELEMENT SETS FOR THIS SATELLITE        1

        ***************** END OF REPORT *****************
```

Figure H-63. GTDS Permanent Elements File Directory Report

GTDS FILRPT PROGRAM

DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- PERMANENT ELEMENTS

****** PERMANENT ELEMENTS FILE SUMMARY REPORT FOR SATELLITE 7410501 ******

ELEMENT SET NO.	EPOCH YYMMDD.	EPOCH HHMMSS.SSS	OBS START TIME YYMMDD.	OBS START TIME HHMMSS.SSS	OBS END TIME YYMMDD.	OBS END TIME HHMMSS.SSS	NO. OBS	CONVERGE /DIVERGE	RMSFIT
1	761103.	0.0	761102	24917.000	761103	212842.000	66	DIVERGED	4.283601D+01
18	761103.	0.0	761102	24917.000	761103	212842.000	66	CONVERGING	2.528987D+02
16	761103.	0.0	761102	24917.030	761103	212842.000	66	CONVERGING	2.928987D+02

****** PERMANENT ELEMENTS FILE SUMMARY REPORT FOR SATELLITE 6611001 ******

ELEMENT SET NO.	EPOCH YYMMDD.	EPOCH HHMMSS.SSS	OBS START TIME YYMMDD.	OBS START TIME HHMMSS.SSS	OBS END TIME YYMMDD.	OBS END TIME HHMMSS.SSS	NO. OBS	CONVERGE /DIVERGE	RMSFIT
2	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	9.645103D+04
3	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	8.342584D+03
4	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	8.342584D+03
5	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	8.342584D+03
6	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	8.342584D+03
7	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	8.342584D+03
8	711026.	173000.000	711027	182920.000	711029	200221.256	98	CONVERGING	3.127445D+01
9	711026.	173000.000	711027	182920.000	711029	200221.256	98	CONVERGING	3.127448D+01
10	711026.	173000.000	711027	182920.000	711029	200221.256	97	CONVERGED	1.065220D-01
11	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	8.826237D+02
14	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	9.628508D+04
46	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	4.894158D+00
47	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	4.894158D+00
48	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	4.894158D+00
53	711026.	173000.000	711027	182920.000	711029	200221.256	80	CONVERGING	1.087705D+02
58	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	7.496931D+00
55	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	7.496931D+00
64	711026.	173000.000	711027	182920.000	711029	200221.256	122	CONVERGING	7.496931D+00

****** PERMANENT ELEMENTS FILE SUMMARY REPORT FOR SATELLITE 7510701 ******

ELEMENT SET NO.	EPOCH YYMMDD.	EPOCH HHMMSS.SSS	OBS START TIME YYMMDD.	OBS START TIME HHMMSS.SSS	OBS END TIME YYMMDD.	OBS END TIME HHMMSS.SSS	NO. OBS	CONVERGE /DIVERGE	RMSFIT
18	761003.	220000.000	761003	235700.000	761004	70000.000	86	CONVERGED	9.314874D+00

Figure H-64. GTDS Permanent Elements File Satellite Summary Report (1 of 2)

GTDS FILEEFF PROGRAM

DATA MANAGEMENT EFFECT OF THE PERMANENT FILES -- PERMANENT ELEMENTS

****** PERMANENT ELEMENTS FILE SUMMARY REPORT FOR SATELLITE 7610701 ******

ELEMENT SET NO.	EPOCH YYMMDD.	EPOCH HHMMSS.SSS	OBS START TIME YYMMDD.	OBS START TIME HHMMSS.SSS	OBS END TIME YYMMDD.	OBS END TIME HHMMSS.SSS	NO. OBS	CONVERGE /DIVERGE	RMSFIT
44	770510.	161400.000	770510	5300.000	770510	151210.000	42	CONVERGING	0.1003030D+04

****** PERMANENT ELEMENTS FILE SUMMARY REPORT FOR SATELLITE 7502801 ******

ELEMENT SET NO.	EPOCH YYMMDD.	EPOCH HHMMSS.SSS	OBS START TIME YYMMDD.	OBS START TIME HHMMSS.SSS	OBS END TIME YYMMDD.	OBS END TIME HHMMSS.SSS	NO. OBS	CONVERGE /DIVERGE	RMSFIT
13	761030.	0.0	761026	1236.000	761102	235011.000	94	CONVERGED	8.8420390D-01
28	770330.	0.0	770322	5700.000	770329	204530.000	79	CONVERGED	1.0011540D+00
34	770330.	0.0	770322	5700.000	770329	204530.000	79	CONVERGED	1.0011540D+00
35	770402.	0.0	770329	22325.000	770406	211040.000	117	CONVERGED	8.1047030D-01
38	770409.	0.0	770405	405.000	770412	235037.000	121	CONVERGED	7.2833280D-01
39	770414.	0.0	770412	3237.000	770419	202407.000	107	CONVERGED	7.0430880D-01
40	770423.	0.0	770419	10023.000	770426	190401.000	73	CONVERGED	8.2460900D-01
41	770430.	0.0	770426	23641.000	770503	193247.000	139	CONVERGED	1.6703760D+00
43	770517.	0.0	770503	801.000	770510	235304.000	116	CONVERGED	1.4824420D+00
48	770510.	0.0	770510	3400.000	770517	163313.009	117	CONVERGED	9.8426210D-01
12	761029.	0.0	761023	25112.364	761011	235540.363	200	CONVERGED	6.4612760D-01

****** PERMANENT ELEMENTS FILE SUMMARY REPORT FOR SATELLITE 7607701 ******

ELEMENT SET NO.	EPOCH YYMMDD.	EPOCH HHMMSS.SSS	OBS START TIME YYMMDD.	OBS START TIME HHMMSS.SSS	OBS END TIME YYMMDD.	OBS END TIME HHMMSS.SSS	NO. OBS	CONVERGE /DIVERGE	RMSFIT
13	770101.	0.0	761231	3637.300	770102	83710.000	170	CONVERGED	9.0328800D-01
15	770205.	0.0	770203	641.030	770207	90030.000	270	CONVERGED	1.4750130D+00
20	770212.	0.0	770212	3933.000	770214	80634.003	155	CONVERGED	7.9476320D-01
21	770212.	0.0	770210	11722.000	770214	56034.001	331	CONVERGED	1.4245500D+00
25	770220.	0.0	770218	5716.600	770222	73044.000	265	CONVERGED	2.3659480D+00
30	770703.	0.0	770702	5730.000	770706	83019.000	290	CONVERGED	1.0204280D+00
32	770714.	0.0	770715	14445.000	770718	224444.003	310	CONVERGED	1.0965130D+00
33	770723.	0.0	770722	16737.600	770725	234851.003	313	CONVERGED	9.6568030D-01
44	770618.	0.0	770617	6845.000	770621	72026.000	301	CONVERGING	2.3420060D+01
66	770618.	0.0	770617	4531.000	770621	72026.000	303	CONVERGED	9.3090480D-01

Figure H-64. GTDS Permanent Elements File Satellite Summary Report (2 of 2)

elements. A portion of the full element set report is shown in Figure H-65. All reports of the GTDS Permanent Elements File are controlled by keyword card ELSRPT.

H.10.6 INTEGRATION COEFFICIENTS FILE REPORTS

The Integration Coefficients File provides predictor and corrector coefficients for the Cowell integrators for various integration orders. A summary report of the file (Figure H-66) contains a list of all orders represented on the file and the number of coefficients defined for each order. An actual data printout of coefficient values for a requested order is also available (Figure H-67). See keyword card INTCRPT in Section 4 for more details.

H.10.7 LUNAR POTENTIAL FIELDS FILE REPORTS

The Lunar Potential Fields File contains sets (models) of harmonic coefficients defining the lunar gravity field. The reports are the same as those described for the Earth Potential Fields File (Section H.10.3) except that lunar data rather than Earth data is reported. A sample summary report is shown in Figure H-68. A section from the full report is shown in Figure H-69. Both reports are controlled by keyword card LPOTRPT.

H.10.8 SOLAR/LUNAR/PLANETARY (SLP) EPHEMERIS FILE REPORTS

The SLP Ephemeris File contains coefficients of polynomials representing curve-fits of solar, lunar, and planetary orbits and also contains coefficients for use in computing transformation matrices. The full report contains a summary of the timespan and bodies included on the file, followed by a printout of the data associated with each fit. An excerpt from the full report is given in Figure H-70. This report, which is controlled by matrix order, is generated via the SLPRPT keyword card. If a report by body is needed, the

```
                                        GTDS FILEEFT PROGRAM
                 DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- PERMANENT ELEMENTS
                              FULL REPORT OF PERMANENT ELEMENTS FILE
 SATELLITE ID NUMBER [illegible]
 ELEMENT SET NUMBER           1
                                                YY MM DD HH MM SS.SSS
  EPOCH TIME FOR ELEMENTS:                      [illegible]
  START TIME OF FITTED DATA:                    [illegible]
  END TIME OF FITTED DATA:                      [illegible]
  RMS OF FIT:                                   [illegible]
  REFERENCE COORDINATE SYSTEM:                  TRUE OF DATE
  CENTRAL BODY:                                 EARTH
  NUMBER OF OBS IN OBS WORKING FILE:              66
  NUMBER OF OBS TO GENERATE ELEMENT SET:          66
  CONVERGING / DIVERGING INDICATOR              D.C. WAS CONVERGING BUT MAXIMUM NO. OF ITERATIONS EXCEEDED
  ORBIT THEORY USED                             BROUWER-LYDDANE
  ATMOSPHERIC MODEL USED:                       JACCHIA-ROBERTS
  BROUWER DRAG PARAMETERS AND ASSOCIATED TIME VALUES
         NPQ(2,01)   [illegible]                DPQ(2,01)   0.0        NPQ(3,01)   [illegible]      TNPQ:      0.0
  CARTESIAN COORDINATES
         X    [illegible] KM          Y    [illegible] KM         Z    [illegible] KM
         DX   [illegible] KM/S        DY   [illegible] KM/S       DZ   [illegible] KM/S
  KEPLERIAN ELEMENTS
         SMA  [illegible] KM          ECC  [illegible]            INC  [illegible] DEG
         LAN  [illegible] DEG         PA   [illegible] DEG        MA   [illegible] DEG
  APOGEE HEIGHT(KM):                            [illegible]
  PERIGEE HEIGHT(KM):                           [illegible]
  PERIOD(MINS):                                 [illegible]
************************************************************************************************
 SATELLITE ID NUMBER [illegible]
 ELEMENT SET NUMBER           15
                                                YY MM DD HH MM SS.SSS
  EPOCH TIME FOR ELEMENTS:                      [illegible]
  START TIME OF FITTED DATA:                    [illegible]
  END TIME OF FITTED DATA:                      [illegible]
  RMS OF FIT:                                   [illegible]
  REFERENCE COORDINATE SYSTEM:                  TRUE OF DATE
  CENTRAL BODY:                                 EARTH
  NUMBER OF OBS IN OBS WORKING FILE:              66
  NUMBER OF OBS TO GENERATE ELEMENT SET:          66
  CONVERGING / DIVERGING INDICATOR              D.C. WAS CONVERGING
  ORBIT THEORY USED                             BROUWER-LYDDANE
  ATMOSPHERIC MODEL USED:                       JACCHIA-ROBERTS
  BROUWER DRAG PARAMETERS AND ASSOCIATED TIME VALUES
         NPQ(2,01)   [illegible]                DPQ(2,01)   0.0        NPQ(3,01)   0.0              TNPQ:      0.0
  CARTESIAN COORDINATES
         X    [illegible] KM          Y    [illegible] KM         Z    [illegible] KM
         DX   [illegible] KM/S        DY   [illegible] KM/S       DZ   [illegible] KM/S
  KEPLERIAN ELEMENTS
         SMA  [illegible] KM          ECC  [illegible]            INC  [illegible] DEG
         LAN  [illegible] DEG         PA   [illegible] DEG        MA   [illegible] DEG
  APOGEE HEIGHT(KM):                            [illegible]
  PERIGEE HEIGHT(KM):                           [illegible]
  PERIOD(MINS):                                 [illegible]
************************************************************************************************
 SATELLITE ID NUMBER [illegible]
 ELEMENT SET NUMBER           16
                                                YY MM DD HH MM SS.SSS
  EPOCH TIME FOR ELEMENTS:                      [illegible]
  START TIME OF FITTED DATA:                    [illegible]
  END TIME OF FITTED DATA:                      [illegible]
  RMS OF FIT:                                   [illegible]
  REFERENCE COORDINATE SYSTEM:                  TRUE OF DATE
  CENTRAL BODY:                                 EARTH
  NUMBER OF OBS IN OBS WORKING FILE:              66
  NUMBER OF OBS TO GENERATE ELEMENT SET:          66
  CONVERGING / DIVERGING INDICATOR              D.C. WAS CONVERGING
  ORBIT THEORY USED                             BROUWER-LYDDANE
  ATMOSPHERIC MODEL USED:                       JACCHIA-ROBERTS
  BROUWER DRAG PARAMETERS AND ASSOCIATED TIME VALUES
         NPQ(2,01)   [illegible]                DPQ(2,01)   0.0        NPQ(3,01)   0.0              TNPQ:      0.0
  CARTESIAN COORDINATES
         X    [illegible] KM          Y    [illegible] KM         Z    [illegible] KM
         DX   [illegible] KM/S        DY   [illegible] KM/S       DZ   [illegible] KM/S
  KEPLERIAN ELEMENTS
         SMA  [illegible] KM          ECC  [illegible]            INC  [illegible] DEG
         LAN  [illegible] DEG         PA   [illegible] DEG        MA   [illegible] DEG
  APOGEE HEIGHT(KM):                            [illegible]
  PERIGEE HEIGHT(KM):                           [illegible]
  PERIOD(MINS):                                 [illegible]
************************************************************************************************
```

Figure H-65. GTDS Permanent Elements File Full Report (1 of 2)

```
                         GTDS FILEDEF PROGRAM
      DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- PERMANENT ELEMENTS
                  FULL REPORT OF PERMANENT ELEMENTS FILE
SATELLITE ID NUMBER: 6611001
ELEMENT SET NUMBER:        2
                                        YY MM DD HH MM SS.SSS
 EPOCH TIME FOR ELEMENTS:               71 10 26 17 33 33.333
 START TIME OF FITTED DATA:             71 10 27 10 29 20.000
 END TIME OF FITTED DATA:               71 10 29 10 02 21.282
 RMS OF FIT:                            [illegible]
 REFERENCE COORDINATE SYSTEM:           TRUE OF DATE
 CENTRAL BODY:                          EARTH
 NUMBER OF OBS IN OBS WORKING FILE:      122
 NUMBER OF OBS TO GENERATE ELEMENT SET:  122
 CONVERGING / DIVERGING INDICATOR       D.C. WAS CONVERGING
 ORBIT THEORY USED                      COWELL
 ATMOSPHERIC MODEL USED:                JACCHIA-ROBERTS
 COWELL DRAG PARAMETERS:
       RHO1:              0.0                 RHO2:              0.0
 CARTESIAN COORDINATES
       X    [illegible] KM          Y    [illegible] KM        Z    [illegible] KM
       DX   [illegible] K/S         DY   [illegible] K/S       DZ   [illegible] K/S
 KEPLERIAN ELEMENTS
       SMA  [illegible] KM          ECC  [illegible]           INC  [illegible] DEG
       LAN  [illegible] DEG         PA   [illegible] DEG       MA   [illegible] DEG
 APOGEE HEIGHT(KM):                      [illegible]
 PERIGEE HEIGHT(KM):                     [illegible]
 PERIOD(MINS):                           [illegible]
*****************************************************************************
SATELLITE ID NUMBER: 6611001
ELEMENT SET NUMBER:        3
                                        YY MM DD HH MM SS.SSS
 EPOCH TIME FOR ELEMENTS:               71 10 26 17 30 30.030
 START TIME OF FITTED DATA:             71 10 27 10 29 20.000
 END TIME OF FITTED DATA:               71 10 29 10 02 21.284
 RMS OF FIT:                            [illegible]
 REFERENCE COORDINATE SYSTEM:           TRUE OF DATE
 CENTRAL BODY:                          EARTH
 NUMBER OF OBS IN OBS WORKING FILE:      122
 NUMBER OF OBS TO GENERATE ELEMENT SET:  122
 CONVERGING / DIVERGING INDICATOR       D.C. WAS CONVERGING
 ORBIT THEORY USED                      COWELL
 ATMOSPHERIC MODEL USED:                JACCHIA-ROBERTS
 COWELL DRAG PARAMETERS:
       RHO1:              0.0                 RHO2:              0.0
 CARTESIAN COORDINATES
       X    [illegible] KM          Y    [illegible] KM        Z    [illegible] KM
       DX   [illegible] K/S         DY   [illegible] K/S       DZ   [illegible] K/S
 KEPLERIAN ELEMENTS
       SMA  [illegible] KM          ECC  [illegible]           INC  [illegible] DEG
       LAN  [illegible] DEG         PA   [illegible] DEG       MA   [illegible] DEG
 APOGEE HEIGHT(KM):                      [illegible]
 PERIGEE HEIGHT(KM):                     [illegible]
 PERIOD(MINS):                           [illegible]
*****************************************************************************
SATELLITE ID NUMBER: 6611001
ELEMENT SET NUMBER:        4
                                        YY MM DD HH MM SS.SSS
 EPOCH TIME FOR ELEMENTS:               71 10 26 17 30 30.030
 START TIME OF FITTED DATA:             71 10 27 10 29 20.000
 END TIME OF FITTED DATA:               71 10 29 10 02 21.2[illegible]
 RMS OF FIT:                            [illegible]
 REFERENCE COORDINATE SYSTEM:           TRUE OF DATE
 CENTRAL BODY:                          EARTH
 NUMBER OF OBS IN OBS WORKING FILE:      122
 NUMBER OF OBS TO GENERATE ELEMENT SET:  122
 CONVERGING / DIVERGING INDICATOR       D.C. WAS CONVERGING
 ORBIT THEORY USED                      COWELL
 ATMOSPHERIC MODEL USED:                JACCHIA-ROBERTS
 COWELL DRAG PARAMETERS:
       RHO1:              0.0                 RHO2:              0.0
 CARTESIAN COORDINATES
       X    [illegible] KM          Y    [illegible] KM        Z    [illegible] KM
       DX   [illegible] K/S         DY   [illegible] K/S       DZ   [illegible] K/S
 KEPLERIAN ELEMENTS
       SMA  [illegible] KM          ECC  [illegible]           INC  [illegible] DEG
       LAN  [illegible] DEG         PA   [illegible] DEG       MA   [illegible] DEG
 APOGEE HEIGHT(KM):                      [illegible]
 PERIGEE HEIGHT(KM):                     [illegible]
 PERIOD(MINS):                           [illegible]
*****************************************************************************
```

Figure H-65. GTDS Permanent Elements File Full Report (2 of 2)

```
                         CTCS  FILERPT  PROGRAM
         DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- INTEGRATION COEFFICIENT

        SUMMARY REPORT

 NUMBER OF RECORDS IN FILE: [illegible]
 LOWEST NUMBER OF COEFFICIENTS:  1
 HIGHEST NUMBER OF COEFFICIENTS: 19

 ORDER NUMBER   3
 NUMBER OF COEFFICIENTS IN RECORD:  1

 ORDER NUMBER   4
 NUMBER OF COEFFICIENTS IN RECORD:  2

 ORDER NUMBER   5
 NUMBER OF COEFFICIENTS IN RECORD:  3

 ORDER NUMBER   6
 NUMBER OF COEFFICIENTS IN RECORD:  4

 ORDER NUMBER   7
 NUMBER OF COEFFICIENTS IN RECORD:  5

 ORDER NUMBER   8
 NUMBER OF COEFFICIENTS IN RECORD:  6

 ORDER NUMBER   9
 NUMBER OF COEFFICIENTS IN RECORD:  7

 ORDER NUMBER  10
 NUMBER OF COEFFICIENTS IN RECORD:  8

 ORDER NUMBER  11
 NUMBER OF COEFFICIENTS IN RECORD:  9

 ORDER NUMBER  12
 NUMBER OF COEFFICIENTS IN RECORD: 10

 ORDER NUMBER  13
 NUMBER OF COEFFICIENTS IN RECORD: 11

 ORDER NUMBER  14
 NUMBER OF COEFFICIENTS IN RECORD: 12

 ORDER NUMBER  15
 NUMBER OF COEFFICIENTS IN RECORD: 13

 ORDER NUMBER  16
 NUMBER OF COEFFICIENTS IN RECORD: 14

 ORDER NUMBER  17
 NUMBER OF COEFFICIENTS IN RECORD: 15

 ORDER NUMBER  18
 NUMBER OF COEFFICIENTS IN RECORD: 16

 ORDER NUMBER  19
 NUMBER OF COEFFICIENTS IN RECORD: 17

 ORDER NUMBER  20
 NUMBER OF COEFFICIENTS IN RECORD: 18

 ORDER NUMBER  21
 NUMBER OF COEFFICIENTS IN RECORD: 19

 END OF PERMANENT INTEGRATION COEFFICIENT REPORT
```

Figure H-66. Integration Coefficients File Summary Report

GTDS FILEMPT PROGRAM PAGE 6

DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- INTEGRATION COEFFICIENT

SPECIFIC REPORT

ORDER NUMBER 10
NUMBER OF COEFFICIENTS IN RECORD: 8

LOCAL ERROR COEFFICIENT FOR POSITION: -2.06778D-03
LOCAL ERROR COEFFICIENT FOR VELOCITY: 3.55615E-02

COEFFICIENT NUMBER	PREDICTOR COEFFICIENTS FOR POSITION	CORRECTOR COEFFICIENTS FOR POSITION	PREDICTOR COEFFICIENTS FOR VELOCITY	CORRECTOR COEFFICIENTS FOR VELOCITY
1	8.89020D-01	6.31404D-02	2.00402D+00	2.94466D-01
2	-1.92803D+00	8.38963D-02	-8.99933D+00	8.25879D-01
3	3.72267D+00	-1.60018D-01	1.73115D+01	-7.43023D-01
4	-4.78227D+00	1.06607D-01	-2.12200D+01	7.46987D-01
5	3.60472D+00	-1.42427D-01	1.67916D+01	-5.80080D-01
6	-1.70713D+00	6.80550D-02	-8.33317D+00	2.78461D-01
7	5.07479D-01	-1.91919D-02	2.36830D+00	-7.68232D-02
8	-6.31404D-02	2.35232D-03	-2.94468D-01	9.35654D-03

END OF PERMANENT INTEGRATION COEFFICIENT REPORT

Figure H-67. Integration Coefficients File Data Report

```
                         GIDS  FILEMPT  PROGRAM
        ******    *********    PERMANENT FILE REPORT    *********    ******
                          PHYSICAL CONSTANTS REFERENCE FILE
                                  SUMMARY REPORT

THE TOTAL NUMBER OF LUNAR POTENTIAL MODELS IN THE FILE IS           8

THE PERMANENT LUNAR POTENTIAL FILE HAS BEEN RUN                     9 MODELS

                 ***** PERMANENT LUNAR POTENTIAL FILE ****

        MODEL NUMBER        MODEL DESCRIPTION
             1              JPL ZERO EXPANSION
             2              LUNAR POTENTIAL ADOPTED REFERENCE SET (GSFC MLI.2)
             3              LUNAR POTENTIAL FOR MANNED FLIGHT COMPUTATIONS (L1)
             4              LUNAR GRAVITY COEFFICIENTS JPL-1
             5              LUNAR GRAVITY COEFFICIENTS JPL-3
             6              LUNAR GRAVITY COEFFICIENTS JPL-4
             7              LUNAR GRAVITY COEFFICIENTS GSFC FIELD 1B
             8              LUNAR GRAVITY COEFFICIENTS LAN (1993)

  **********   **********   **********  END OF PERMANENT FILE REPORT **********   **********   **********
```

Figure H-68. Lunar Potential Fields File Summary Report

```
              MODEL NUMBER          MODEL DESCRIPTION
                   2                LUNAR POTENTIAL ADOPTED REFERENCE SET (GSFC ML1.2)
GRAV CONST(KM**3/SEC**2)     0.4902780D+04
MEAN RADIUS(KM)              0.1738000D+04

          HARMONIC COEFFICIENTS          MOON                                      MAXIMUM DEGREE =   4
                                                                                   MAXIMUM ORDER  =   3
    ZONALS
    INDEX          VALUE               INDEX          VALUE               INDEX          VALUE               INDEX          VALUE
     N  M                               N  M                               N  M                               N  M
     2  0 -.2071000000000000D-03        3  0 0.2100000000000000D-04        4  0 0.0
    SECTORALS AND TESSERALS
    INDEX                     VALUE                                        INDEX                     VALUE
     N  M            C                     S                                N  M            C                     S
     2  1  0.0                        0.0                                   2  2  0.2071000000000000D-04  0.0
     3  1  0.3400000000000000D-04     0.0                                   3  2  0.1012000000000000D-04  0.4790000000000000D-05
     3  3  0.2583000000000000D-05     0.0                                   4  1  -.1284000000000000D-04  0.1590000000000000D-04
     4  2  0.0                        0.0                                   4  3  0.0                     0.0

              MODEL NUMBER          MODEL DESCRIPTION
                   3                LUNAR POTENTIAL FOR MANNED FLIGHT COMPUTATIONS (L1)
GRAV CONST(KM**3/SEC**2)     0.4902778D+04
MEAN RADIUS(KM)              0.1738000D+04

          HARMONIC COEFFICIENTS      -   MOON                                      MAXIMUM DEGREE =   3
                                                                                   MAXIMUM ORDER  =   3
    ZONALS
    INDEX          VALUE               INDEX          VALUE               INDEX          VALUE               INDEX          VALUE
     N  M                               N  M                               N  M                               N  M
     2  0 -.2071000000000000D-03        3  0 0.2100000000000000D-04
    SECTORALS AND TESSERALS
    INDEX                     VALUE                                        INDEX                     VALUE
     N  M            C                     S                                N  M            C                     S
     2  1  0.0                        0.0                                   2  2  0.2071000000000000D-04  0.0
     3  1  0.3400000000000000D-04     0.0                                   3  2  0.0                     0.0
     3  3  0.2583000000000000D-05     0.0
```

Figure H-69. Excerpt From Lunar Potential Fields File Report

```
GIDS FILERPT PROGRAM                                        PAGE 112
GIDS SLP EPHEMERIS      FULL REPORT
              INDEX - SLP-EPHEMERIS  -  FULL REPORT

DATE OF REPORT IS SEPT 23,1981
START TIME OF DATA                                   = JAN  1,1976
NUMBER OF DAYS OF DATA                               =   4400
FINAL TIME OF DATA                                   = JAN 10,1988
NUMBER OF BODIES REPRESENTED BY CURVE-FITS           =  9
CENTRAL BODY FOR POLYNOMIAL COEFFICIENTS             = EARTH
FAST BODY FOR POLYNOMIAL COEFFICIENTS                = MOON
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = SUN
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = MARS
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = JUPITER
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = SATURN
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = URANUS
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = MERCURY
SLOW BODIES FOR POLYNOMIAL COEFFICIENTS              = VENUS
DEGREE OF POLYNOMIALS FOR ROTATIONMATRIX             =   9
DEGREE OF POLYNOMIALS FOR FAST BODY POSITION         =  10
DEGREE OF POLYNOMIALS FOR FAST BODY VELOCITY         =  12
DEGREE OF POLYNOMIALS FOR SLOW BODY POSITION         =   9
NUMBER OF DAYS PER CURVE FIT                         =  20
COORDINATE SYSTEM REFERENCED TO 1950.0
```

Figure H-70. SLP Ephemeris File Report (Excerpt) (1 of 4)

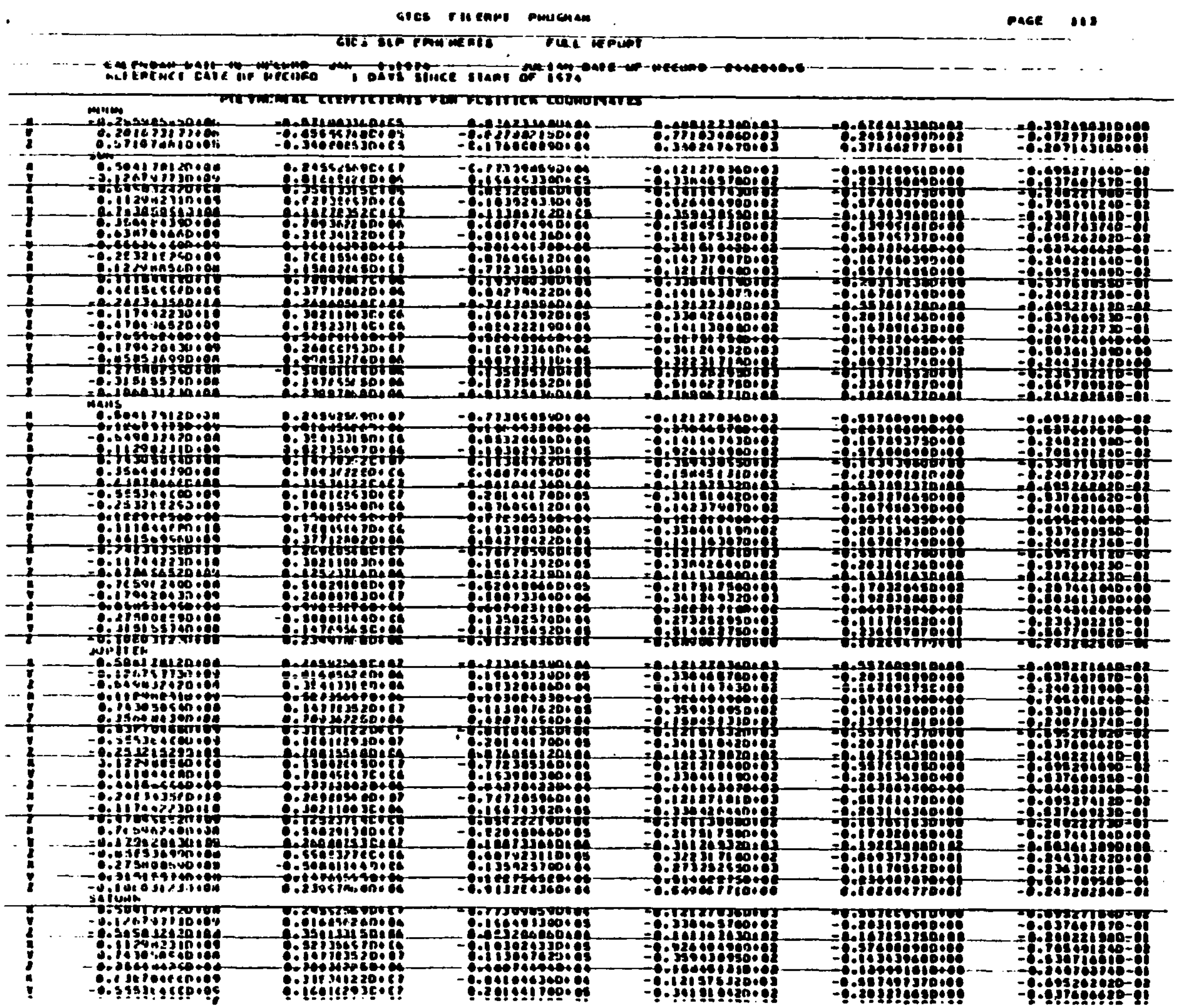

Figure H-70. SLP Ephemeris File Report (Excerpt) (2 of 4)

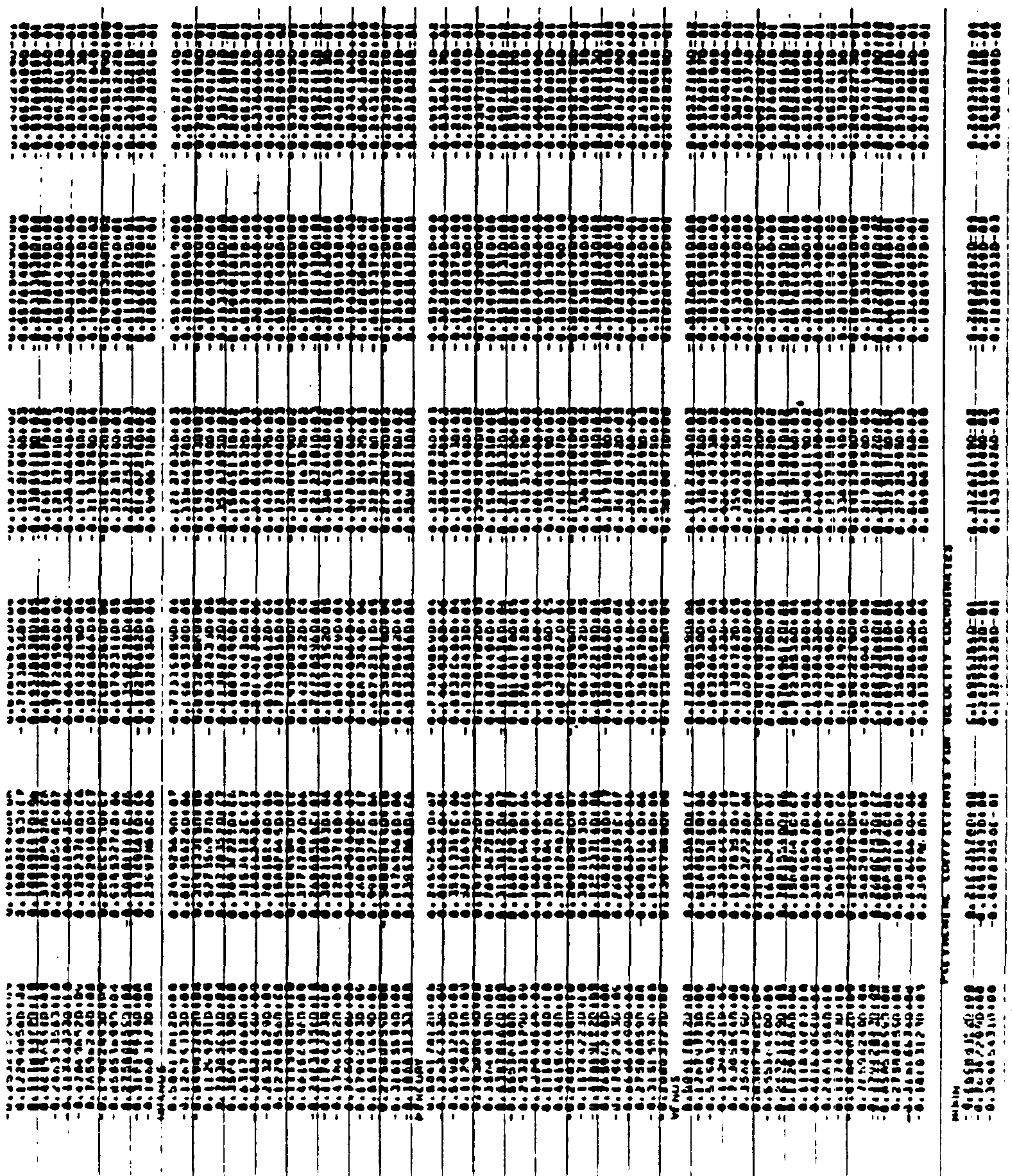

Figure H-70. SLP Ephemeris File Report (Excerpt) (3 of 4)

GIDS FILEREF PROGRAM PAGE 114

GIDS SLP EPHEMERIS FULL REPORT

POLYNOMIAL COEFFICIENTS FOR THE TRANSFORMATION MATRIX FROM SELENOCENTRIC TO SELENOGRAPHIC COORDINATES

DEGREE = 10

ORDER 0			ORDER 1		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 2			ORDER 3		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 4			ORDER 5		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 6			ORDER 7		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 8			ORDER 9		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

POLYNOMIAL COEFFICIENTS FOR THE TRANSFORMATION MATRIX FROM 1950.0 TO TRUE OF DATE COORDINATES

DEGREE = 10

ORDER 0			ORDER 1		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 2			ORDER 3		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 4			ORDER 5		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 6			ORDER 7		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORDER 8			ORDER 9		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

POLYNOMIAL COEFFICIENTS FOR THE DELTA H ARRAY USED IN COMPUTING THE "D" MATRIX

[illegible]

[illegible]

Figure H-70. SLP Ephemeris File Report (Excerpt) (4 of 4)

keyword card SLPELRPT can be used to generate the SLP Elements Report. This report lists the instantaneous elements by body at requested times. An excerpt is shown in Figure H-71.

H.10.9 TRACKING STATION GEODETICS FILE REPORT

The Tracking Station Geodetics File contains position and specification data associated with tracking stations, which may be reported via keyword card GEODRPT. A full report of the file (Figure H-72) provides a list of all stations represented on the file. The data for each station include the station name, number, type, and location in both spherical and Cartesian coordinates. The ellipsoid model used in deriving the station location data is noted, and the constants associated with all ellipsoid models are defined at the end of the report.

H.10.10 24-HOUR HOLD ELEMENTS FILE REPORTS

The 24-Hour Hold Elements File contains elements computed by the DC Program and related information. The reports associated with this file are the same as those described for the GTDS Permanent Elements File in Section H.10.5; in addition, a full report containing all elements for all satellites on the file is available. The directory (summary) report and full report are shown in Figures H-73 and H-74, respectively. See keyword card ELS24RPT for report control information.

H.10.11 PERMANENT MANEUVERS FILE REPORT

An example of the format of this report is given in Figure H-75. The Permanent Maneuvers file is not presently maintained.

SLP ELEMENTS REPORT

START TIME (ET) : 790101 0.0 EPOCH (ET) : 900527 [illegible]
END TIME (ET) : 801101 0.0 EPOCH (UTC) : 900527 0.0

THE INTERVAL BETWEEN THE REQUESTED TIMES IS 0.50000 EPHEMERIS DAY(S)

BODIES: 1 = MOON 5 = SATURN
2 = SUN 6 = URANUS
3 = MARS 7 = MERCURY
4 = JUPITER 8 = VENUS

ELEMENTS: CARTESIAN POSITION X, Y, Z (KM)
CARTESIAN VELOCITY Ẋ, Ẏ, Ż (KM/SEC)
RIGHT ASCENSION RA (HOURS, MINUTES, SECONDS)
DECLINATION D (DEGREES, MINUTES, SECONDS)
RANGE R (KM) COORDINATE SYSTEM IS [illegible]

[illegible] 0.0 (ET)
JD (UTC) = [illegible] JD (ET) = [illegible] SECONDS FROM EPOCH = [illegible]

INSTANTANEOUS ELEMENTS

BODY	X (RA)	Y (DEC)	Z (R)	Ẋ	Ẏ	Ż
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

APPARENT ELEMENTS (LIGHT TIME CORRECTION APPLIED)

BODY	X (RA)	Y (DEC)	Z (R)	Ẋ	Ẏ	Ż
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure H-71. SLP Elements Report

GTCS FILERPT PROGRAM

STATION GEODETICS FILE REPORT

INDEX - STATION GEODETICS FILE REPORT

STATION ACRONYM	INDEX NUMBER	TYPE	SPHERICAL COORDINATES DEG MN SEC	CARTESIAN COORD KM		REF ELLIP NO.
ETCA	1	LSMAS	GEODETIC LAT. = 38 59 53.6360 GEOGRAPHIC LONG= 283 9 26.1610 HEIGHT = 4.030 METERS	X= 1129.01860 Y= -4833.11710 Z= 3992.15046	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
GDSA	2	LSPUS	GEODETIC LAT. = 35 20 25.6020 GEOGRAPHIC LONG= 243 7 37.2140 HEIGHT = 613.310 METERS	X= -2354.76083 Y= -4646.81072 Z= 3660.35142	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
GDSB	3	LSDAS	GEODETIC LAT. = 35 20 26.6420 GEOGRAPHIC LONG= 243 7 38.0420 HEIGHT = 618.710 METERS	X= -2354.75945 Y= -4646.78569 Z= 3660.35454	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.7010000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
MADB	4	LSUUS	GEODETIC LAT. = 40 27 19.6860 GEOGRAPHIC LONG= 355 49 53.9560 HEIGHT = 800.600 METERS	X= 4847.42425 Y= -353.31783 Z= 4117.14483	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.7010000000D-02 KM TRANS. FREQ. = 0.2285000000D+04	1
MILA	5	LSHOR	GEODETIC LAT. = 28 30 29.9050 GEOGRAPHIC LONG= 279 18 24.1030 HEIGHT = -58.823 METERS	X= 967.14316 Y= -5530.11722 Z= 3022.11556	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
ACNJ	9	LSANTO	GEODETIC LAT. = -7-57-17.3710 GEOGRAPHIC LONG= 345 40 22.6700 HEIGHT = 528.370 METERS	X= 6121.83250 Y= -1563.36823 Z= -876.81087	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
AGOJ	10	LSRJO	GEODETIC LAT. = -33 -9 -3.8040 GEOGRAPHIC LONG= 289 20 1.0853 HEIGHT = 707.610 METERS	X= 1766.81678 Y= -5044.43127 Z= -3464.36656	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
HOAJ	11	LSEJO	GEODETIC LAT. = 32 21 5.8810 GEOGRAPHIC LONG= 295 20 31.6370 HEIGHT = -33.750 METERS	X= 2309.46199 Y= -4874.31266 Z= 3363.41371	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
ETCJ	13	LSUSC	GEODETIC LAT. = 38 59 56.6860 GEOGRAPHIC LONG= 283 9 26.1610 HEIGHT = -2.600 METERS	X= 1129.86300 Y= -4833.11490 Z= 3992.21062	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
GWMJ	14	LSMIJ	GEODETIC LAT. = 13 18 38.2630 GEOGRAPHIC LONG= 144 44 12.5240 HEIGHT = 115.650 METERS	X= -5060.91722 Y= 3584.14624 Z= 1420.55347	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
HAWJ	15	LSAJO	GEODETIC LAT. = 22 7 34.4610 GEOGRAPHIC LONG= 200 20 5.4390 HEIGHT = 1135.760 METERS	X= -5543.84813 Y= -2054.56535 Z= 2387.81013	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
MILJ	16	LSEJO	GEODETIC LAT. = 28 30 25.7740 GEOGRAPHIC LONG= 279 18 23.0530 HEIGHT = -24.460 METERS	X= 967.38116 Y= -5530.26056 Z= 3026.11267	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
MIL3	17	LSBJO	GEODETIC LAT. = 28 30 27.0630 GEOGRAPHIC LONG= 279 18 23.0530 HEIGHT = -64.420 METERS	X= 987.38561 Y= -5532.33706 Z= 3026.86188	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1
GDSJ	18	LSMJU	GEODETIC LAT. = 35 20 31.5370 GEOGRAPHIC LONG= 243 7 35.5610 HEIGHT = 612.710 METERS	X= -2354.72726 Y= -4646.78491 Z= 3665.44870	N-S VERT DEFL = 0.0 RAD E-W VERT DEFL = 0.0 RAD ANTENNA OFFSET= 0.2438000000D-02 KM TRANS. FREQ. = 0.2200000000D+04	1

Figure H-72. Tracking Station Geodetics File Report

```
                         GIDS FILEAPT PROGRAM
              DATA MANAGEMENT REPORT OF THE 24 HOUR HOLD FILE
                  SUMMARY REPORT OF THE 24 HOUR HOLD FILE

SATELLITE ID NUMBER   0107002
ELEMENT SET NUMBER:            1
                                              YY MM DD HH MM SS.SSS
 EPOCH TIME FOR ELEMENTS:                     81 09 26 00 00 00.000
 START TIME OF FITTED DATA:                   81 09 26 00 29 50.000
 END TIME OF FITTED DATA:                     81 09 27 07 14 50.000
 RMS OF FIT:                                  1.59630D+00
 REFERENCE COORDINATE SYSTEM:                 TRUE OF DATE
 CENTRAL BODY:                                EARTH
 NUMBER OF OBS TO GENERATE ELEMENT SET:        303
 CONVERGING / DIVERGING INDICATOR             D.C. CONVERGED
 ORBIT THEORY USED                            TIME REGULARIZEDCOWELL
 ATMOSPHERIC MODEL USED:                      HARRIS-PRIESTER MODEL NUMBER  6
 CARTESIAN COORDINATES
           X    [illegible] KM       Y    [illegible] KM       Z    [illegible] KM
           DX   [illegible] M/S      DY   [illegible] M/S      DZ   [illegible] M/S
 KEPLERIAN ELEMENTS
           SMA  [illegible] KM       ECC  [illegible]          INC  [illegible] DEG
           LAN  [illegible] DEG      PA   [illegible] DEG      MA   [illegible] DEG
*******************************************************************************
SATELLITE ID NUMBER   0107002
ELEMENT SET NUMBER:            2
                                              YY MM DD HH MM SS.SSS
 EPOCH TIME FOR ELEMENTS:                     81 09 26 00 30 00.000
 START TIME OF FITTED DATA:                   81 09 26 00 29 50.000
 END TIME OF FITTED DATA:                     81 09 27 07 14 50.000
 RMS OF FIT:                                  1.52323D+00
 REFERENCE COORDINATE SYSTEM:                 TRUE OF DATE
 CENTRAL BODY:                                EARTH
 NUMBER OF OBS TO GENERATE ELEMENT SET:        326
 CONVERGING / DIVERGING INDICATOR             D.C. CONVERGED
 ORBIT THEORY USED                            TIME REGULARIZEDCOWELL
 ATMOSPHERIC MODEL USED:                      HARRIS-PRIESTER MODEL NUMBER  6
 CARTESIAN COORDINATES
           X    [illegible] KM       Y    [illegible] KM       Z    [illegible] KM
           DX   [illegible] M/S      DY   [illegible] M/S      DZ   [illegible] M/S
 KEPLERIAN ELEMENTS
           SMA  [illegible] KM       ECC  [illegible]          INC  [illegible] DEG
           LAN  [illegible] DEG      PA   [illegible] DEG      MA   [illegible] DEG
*******************************************************************************
SATELLITE ID NUMBER   0107002
ELEMENT SET NUMBER:            3
                                              YY MM DD HH MM SS.SSS
 EPOCH TIME FOR ELEMENTS:                     81 09 26 00 00 00.000
 START TIME OF FITTED DATA:                   81 09 26 00 29 50.000
 END TIME OF FITTED DATA:                     81 09 27 07 14 50.000
 RMS OF FIT:                                  1.57166D+00
 REFERENCE COORDINATE SYSTEM:                 TRUE OF DATE
 CENTRAL BODY:                                EARTH
 NUMBER OF OBS TO GENERATE ELEMENT SET:        331
 CONVERGING / DIVERGING INDICATOR             D.C. CONVERGED
 ORBIT THEORY USED                            TIME REGULARIZEDCOWELL
 ATMOSPHERIC MODEL USED:                      HARRIS-PRIESTER MODEL NUMBER  6
 CARTESIAN COORDINATES
           X    [illegible] KM       Y    [illegible] KM       Z    [illegible] KM
           DX   [illegible] M/S      DY   [illegible] M/S      DZ   [illegible] M/S
 KEPLERIAN ELEMENTS
           SMA  [illegible] KM       ECC  [illegible]          INC  [illegible] DEG
           LAN  [illegible] DEG      PA   [illegible] DEG      MA   [illegible] DEG
*******************************************************************************
```

Figure H-73. 24-Hour Hold Elements File Summary Report

```
                          CTEF  FILEMNT  PROGRAM
              DATA MANAGEMENT REPORT OF THE 24 HOUR HOLD FILE

SATELLITE ID NUMBER   [illegible]
ELEMENT SET NUMBER:        6

EPOCH TIME FOR ELEMENTS:                  YY MM DD HH MM SS.SSS
START TIME OF FITTED DATA:                [illegible]
END TIME OF FITTED DATA:                  [illegible]
RMS OF FIT:                               [illegible]
REFERENCE COORDINATE SYSTEM:              TRUE OF DATE
CENTRAL BODY:                             EARTH
NUMBER OF OBS TO GENERATE ELEMENT SET:    [illegible]
CONVERGING / DIVERGING INDICATOR          C.C. CONVERGED
ORBIT THEORY USED                         CCDELL
ATMOSPHERIC MODEL USED:                   HARRIS-PRIESTER MODEL NUMBER  9
CARTESIAN COORDINATES
   X    [illegible] KM      Y    [illegible] KM      Z    [illegible] KM
   DX   [illegible] K/S     DY   [illegible] K/S     DZ   [illegible] K/S
KEPLERIAN ELEMENTS
   SMA  [illegible] KM      ECC  [illegible]         INC  [illegible] DEG
   LAN  [illegible] DEG     PA   [illegible] DEG     MA   [illegible] DEG
SOLAR RADIATION PRESSURE COEFFICIENT:  [illegible]
DRAG COEFFICIENTS
   CSUBD2   [illegible]    AR01  [illegible]    AR02  0.0    AR03  0.0
THRUST MODEL COEFFICIENTS
   0.0      0.0      0.0      0.0      0.0
RIGHT ASCENSION
   0.0      0.0      0.0      0.0      0.0
DECLINATION
   0.0      0.0      0.0      0.0      0.0
*****************************************************************************
SATELLITE ID NUMBER   [illegible]
ELEMENT SET NUMBER:        6

EPOCH TIME FOR ELEMENTS:                  YY MM DD HH MM SS.SSS
START TIME OF FITTED DATA:                [illegible]
END TIME OF FITTED DATA:                  [illegible]
RMS OF FIT:                               [illegible]
REFERENCE COORDINATE SYSTEM:              TRUE OF DATE
CENTRAL BODY:                             EARTH
NUMBER OF OBS TO GENERATE ELEMENT SET:    [illegible]
CONVERGING / DIVERGING INDICATOR          D.C. CONVERGED
ORBIT THEORY USED                         CCDELL
ATMOSPHERIC MODEL USED:                   HARRIS-PRIESTER MODEL NUMBER  9
CARTESIAN COORDINATES
   X    [illegible] KM      Y    [illegible] KM      Z    [illegible] KM
   DX   [illegible] K/S     DY   [illegible] K/S     DZ   [illegible] K/S
KEPLERIAN ELEMENTS
   SMA  [illegible] KM      ECC  [illegible]         INC  [illegible] DEG
   LAN  [illegible] DEG     PA   [illegible] DEG     MA   [illegible] DEG
SOLAR RADIATION PRESSURE COEFFICIENT:  [illegible]
DRAG COEFFICIENTS
   CSUBD2   [illegible]    AR01  [illegible]    AR02  0.0    AR03  0.0
THRUST MODEL COEFFICIENTS
   0.0      0.0      0.0      0.0      0.0
RIGHT ASCENSION
   0.0      0.0      0.0      0.0      0.0
DECLINATION
   0.0      0.0      0.0      0.0      0.0
*****************************************************************************
SATELLITE ID NUMBER   [illegible]
ELEMENT SET NUMBER:        6

EPOCH TIME FOR ELEMENTS:                  YY MM DD HH MM SS.SSS
START TIME OF FITTED DATA:                [illegible]
END TIME OF FITTED DATA:                  [illegible]
RMS OF FIT:                               [illegible]
REFERENCE COORDINATE SYSTEM:              TRUE OF DATE
CENTRAL BODY:                             EARTH
NUMBER OF OBS TO GENERATE ELEMENT SET:    [illegible]
CONVERGING / DIVERGING INDICATOR          C.C. CONVERGED
ORBIT THEORY USED                         CCDELL
ATMOSPHERIC MODEL USED:                   HARRIS-PRIESTER MODEL NUMBER  9
CARTESIAN COORDINATES
   X    [illegible] KM      Y    [illegible] KM      Z    [illegible] KM
   DX   [illegible] K/S     DY   [illegible] K/S     DZ   [illegible] K/S
KEPLERIAN ELEMENTS
   SMA  [illegible] KM      ECC  [illegible]         INC  [illegible] DEG
   LAN  [illegible] DEG     PA   [illegible] DEG     MA   [illegible] DEG
SOLAR RADIATION PRESSURE COEFFICIENT:  [illegible]
DRAG COEFFICIENTS
   CSUBD2   [illegible]    AR01  [illegible]    AR02  0.0    AR03  0.0
THRUST MODEL COEFFICIENTS
   0.0      0.0      0.0      0.0      0.0
RIGHT ASCENSION
   0.0      0.0      0.0      0.0      0.0
```

Figure H-74. 24-Hour Hold Elements File Full Report (1 of 2)

```
DECLINATION
         0.0                0.0                0.0                0.0                0.0
**********************************************************************************************
SATELLITE ID NUMBER   75[illegible]
ELEMENT SET NUMBER:          7

EPOCH TIME FOR ELEMENTS:                    YY MM DD HH MM SS.SSS
START TIME OF FITTED DATA:                  81 04 14 08 47 2[illegible].000
END TIME OF FITTED DATA:                    81 04 16 07 28 30.000
RMS OF FIT:                                 1.[illegible]D+01
REFERENCE COORDINATE SYSTEM:                TRUE OF DATE
CENTRAL BODY:                               EARTH
NUMBER OF CASE TO GENERATE ELEMENT SET:     24
CONVERGING / DIVERGING INDICATOR            D.C. CONVERGED
ORBIT THEORY USED                           COWELL
ATMOSPHERIC MODEL USED:                     HARRIS-PRIESTER MODEL NUMBER  0
CARTESIAN COORDINATES
     X    [illegible]D+03 KM    Y    1.5[illegible]D+03 KM    Z    3.3[illegible]D+03 KM
     DX   -1.[illegible]D-01 K/S   DY   6.7[illegible]D+00 K/S   DZ   -3.6[illegible]D+00 K/S
KEPLERIAN ELEMENTS
     SMA  [illegible]D+03 KM    ECC  [illegible]D-03          INC  [illegible]D+01 DEG
     LAN  [illegible]D+02 DEG   PA   [illegible]D+02 DEG      MA   1.[illegible]D+02 DEG
SOLAR RADIATION PRESSURE COEFFICIENT:   1.2000000D+00
DRAG COEFFICIENTS
     CSUBC2     2.[illegible]D+00   RH01   -2.0[illegible]D-02     RH02   0.0     RH03   0.0
THRUST MODEL COEFFICIENTS
         0.0                0.0                0.0                0.0                0.0
RIGHT ASCENSION
         0.0                0.0                0.0                0.0                0.0
DECLINATION
         0.0                0.0                0.0                0.0                0.0
**********************************************************************************************
```

Figure H-74. 24-Hour Hold Elements File Full Report (2 of 2)

```
                         GTDS FILEDIT PROGRAM
        DATA MANAGEMENT REPORT OF THE PERMANENT FILES -- PERMANENT MANEUVERS

*** START OF REPORT*****

TOTAL NUMBER OF RECORDS IN THE MANEUVERS FILE      [illegible]
NEXT AVAILABLE RECORD IN THE MANEUVERS FILE      [illegible]

SATELLITE IDENTIFICATION NUMBER      9999
SATELLITE IDENTIFICATION NUMBER      4444
SATELLITE IDENTIFICATION NUMBER         4
SATELLITE IDENTIFICATION NUMBER         6
SATELLITE IDENTIFICATION NUMBER         8
SATELLITE IDENTIFICATION NUMBER         8
SATELLITE IDENTIFICATION NUMBER         8
SATELLITE IDENTIFICATION NUMBER         8
SATELLITE IDENTIFICATION NUMBER         6
SATELLITE IDENTIFICATION NUMBER         8
SATELLITE IDENTIFICATION NUMBER         8
SATELLITE IDENTIFICATION NUMBER         6
******* END OF REPORT **********
```

Figure H-75. Permanent Maneuvers File Report

H.11 THMODEL PROGRAM OUTPUT

The THMODEL Program outputs its result to FSF and writes a report to the user. Figure H-76 shows the FSF Directory and flight section information of a satellite. In addition to data such as thrust coefficients, integration stepsize, mass, and mass rate, which are specific for a burn, it also outputs default values for many parameters as GTDS does in the normal process of an EPHEM run for orbit propagation through flight sections. The report to the user consists mainly of the following three parts:

- The EPHEM run report describing the orbit propagation from the ignition state to the time of burnout, assuming no thrust
- The processing output report at each iteration when a new estimated thrust has been applied, including the propagator report from the EPHEM Program showing all types of system coordinates for the initial and end states of propagation (Figure H-77 shows a sample of this report.)
- The final report as shown in Figure H-78

```
**********************************************************************
                        *****  *****  ****   *****
                        *        *    *   *  *
                        *  **    *    *   *  *****
                        *   *    *    *   *      *
                        *****    *    ****   *****
-------------------- FLIGHT SECTION FILE  (FSF) --------------------
DIRECTORY
---------
```

SAT ID	REC #	SAT ID	REC #	SAT ID	REC #
1234567	81	0000000	265	0000000	449
0000000	633	0000000	817	0000000	1001
0000000	1185	0000000	1369	0000000	1553
0000000	1737	0000000	1921	0000000	2105
0000000	2289	0000000	2473	0000000	2657

END OF DIRECTORY --

Figure H-76. Sample of THMODEL Program Output to Flight Section File (1 of 3)

```
******************************************************************************
SATELLITE                             =      1234567
NOMINAL LIFT-OFF TIME (GMT)           =      YYMMDDHHMMSS.SSS
ACTUAL LIFT-OFF TIME (GMT)            =      YYMMDDHHMMSS.SSS
TOTAL NUMBER OF SECTIONS WRITTEN =           5
------------------------------------------------------------------------------
DEFINITIONS OF SOME ABBREVIATIONS USED IN SECTION INFORMATION:
 MAXDEGEQ = MAXIMUM DEGREE TO BE USED TO EVALUATE NONSPHERICAL POTENTIAL
 MAXORDEQ = MAXIMUM ORDER OF THE NONSPHERICAL POTENTIAL
 P = PITCH ANGLE (DEGREES)                      Y = YAW ANGLE (DEGREES)
 T = THRUST ACCELERATION (KM/S2)                DOT = RATE
 A1-A6 = DRAG POLYNOMLIAL COEFFICIENTS
 DRAG POL = TOTAL NUMBER OF DRAG COEFFICIENTS TO BE USED
 AREA = SPACECRAFT CROSS SECTIONAL AREA (KM2)
 SOL RAD = SOLAR RADIATION
 FOR INTEGRATION STARTER: 1=MULTI-STEP, 2=RUNGE-KUTTA
------------------------------------------------------------------------------

SECTION =  1 -----------------------------------------------------------------
 DURATION = 0.00000000000000000000D+00      STEP SIZE = 0.240000000000000D+02
 MAXDEGEQ = 4          MAXORDEQ =    4      INTEGRATION STARTER   =          1
 THRUST SWITCH   = 2  (1=ON, 2=OFF)
    P  =  0.00000000000000000000D+00        PDOT =   0.00000000000000000000D+00
    Y  =  0.00000000000000000000D+00        YDOT =   0.00000000000000000000D+00
    T  =  0.00000000000000000000D+00        TDOT =   0.00000000000000000000D+00
 DRAG SWITCH       = 2  (1=ON, 2=OFF)
    A1 =  0.00000000000000000000D+00        A2   =   0.00000000000000000000D+00
    A3 =  0.00000000000000000000D+00        A4   =   0.00000000000000000000D+00
    A5 =  0.00000000000000000000D+00        A6   =   0.00000000000000000000D+00
    DRAG POL       = 1                      AREA =   0.00000000000000000000D+00
 SOL RAD SWITCH = 2  (1=ON, 2=OFF)
 MASS   =  0.00000000000000000000D+00       MASS RATE = 0.000000000000000D+00

SECTION =  2 -----------------------------------------------------------------
 DURATION = 0.60000000000000000000D+02      STEP SIZE = 0.100000000000000D+01
 MAXDEGEQ = 4          MAXORDEQ =    4      INTEGRATION STARTER   =          1
 THRUST SWITCH   = 1  (1=ON, 2=OFF)
    P  =  0.17188700000000000008D+02        PDOT =   -.57300000000000000002D-01
    Y  =  0.17188700000000000008D+02        YDOT =   -.57300000000000000002D-01
    T  =  0.21739129999999999997D-02        TDOT =   0.40913999999999999996D-06
 DRAG SWITCH       = 2  (1=ON, 2=OFF)
    A1 =  0.00000000000000000000D+00        A2   =   0.00000000000000000000D+00
    A3 =  0.00000000000000000000D+00        A4   =   0.00000000000000000000D+00
    A5 =  0.00000000000000000000D+00        A6   =   0.00000000000000000000D+00
    DRAG POL       = 1                      AREA =   0.11121999999999999999D-03
 SOL RAD SWITCH = 2  (1=ON, 2=OFF)
 MASS   =  0.92000000000000000000D+05       MASS RATE = -.1666666000000000D+02

SECTION =  3 -----------------------------------------------------------------
 DURATION = 0.00000000000000000000D+00      STEP SIZE = 0.240000000000000D+02
 MAXDEGEQ = 4          MAXORDEQ =    4      INTEGRATION STARTER   =          1
 THRUST SWITCH   = 2  (1=ON, 2=OFF)
    P  =  0.00000000000000000000D+00        PDOT =   0.00000000000000000000D+00
    Y  =  0.00000000000000000000D+00        YDOT =   0.00000000000000000000D+00
    T  =  0.00000000000000000000D+00        TDOT =   0.00000000000000000000D+00
 DRAG SWITCH       = 2  (1=ON, 2=OFF)
    A1 =  0.00000000000000000000D+00        A2   =   0.00000000000000000000D+00
    A3 =  0.00000000000000000000D+00        A4   =   0.00000000000000000000D+00
    A5 =  0.00000000000000000000D+00        A6   =   0.00000000000000000000D+00
    DRAG POL       = 1                      AREA =   0.00000000000000000000D+00
 SOL RAD SWITCH = 2  (1=ON, 2=OFF)
 MASS   =  0.91000000000000000000D+05       MASS RATE = 0.000000000000000D+00

SECTION =  4 -----------------------------------------------------------------
 DURATION = 0.60000000000000000000D+02      STEP SIZE = 0.100000000000000D+01
 MAXDEGEQ = 4          MAXORDEQ =    4      INTEGRATION STARTER   =          1
 THRUST SWITCH   = 1  (1=ON, 2=OFF)
    P  =  0.17203830730000000000D+02        PDOT =   -.57266896710000000001D-01
    Y  =  0.17191317300000000015D+02        YDOT =   -.57408089879999999998D-01
    T  =  0.21733968160000000001D-02        TDOT =    .40689035390000000005D-06
 DRAG SWITCH       = 2  (1=ON, 2=OFF)
    A1 =  0.00000000000000000000D+00        A2   =   0.00000000000000000000D+00
    A3 =  0.00000000000000000000D+00        A4   =   0.00000000000000000000D+00
    A5 =  0.00000000000000000000D+00        A6   =   0.00000000000000000000D+00
    DRAG POL       = 1                      AREA =   0.11121999999999999999D-03
```

Figure H-76. Sample of THMODEL Program Output to Flight Section File (2 of 3)

```
SOL RAD SWITCH = 2  (1=ON, 2=OFF)
MASS   =  0.91000000000000000000D+05      MASS RATE = -.16666660000000D+02

SECTION =  5 ------------------------------------------------------------------
 DURATION = 0.00000000000000000000D+00     STEP SIZE = 0.24000000000000D+02
 MAXDEGEQ = 4        MAXORDEQ =   4        INTEGRATION STARTER   =        1
 THRUST SWITCH   = 2  (1=ON, 2=OFF)
    P   =  0.00000000000000000000D+00      PDOT =   0.00000000000000000000D+00
    Y   =  0.00000000000000000000D+00      YDOT =   0.00000000000000000000D+00
    T   =  0.00000000000000000000D+00      TDOT =   0.00000000000000000000D+00
 DRAG SWITCH      = 2  (1=ON, 2=OFF)
    A1 =   0.00000000000000000000D+00      A2    =  0.00000000000000000000D+00
    A3 =   0.00000000000000000000D+00      A4    =  0.00000000000000000000D+00
    A5 =   0.00000000000000000000D+00      A6    =  0.00000000000000000000D+00
    DRAG POL      = 1                      AREA =   0.00000000000000000000D+00
 SOL RAD SWITCH = 2  (1=ON, 2=OFF)
 MASS   =  0.90000000000000000000D+05      MASS RATE = 0.00000000000000D+00
```

Figure H-76. Sample of THMODEL Program Output to Flight Section File (3 of 3)

```
*********************************************************************************
*                                                                               *
*                                                                               *
*            PROCESSING OUTPUT AT THE END OF ITERATION #    5                   *
*                                                                               *
*                                                                               *
*********************************************************************************

   NOMINAL IGNITION STATE:

              -5684.6304000          3447.4253000          1043.6586000
               -4.0177380000         -5.5761939000         -3.4729043000

   NOMINAL BURNOUT STATE:

              -5914.9859000          3102.3833000           832.4139200
               -3.6560694000         -5.9224374000         -3.5676070000

   ----------------------------------------------------------------------

   NEW ESTIMATED THRUST COEFFICIENTS:
   (PITCH AND YAW IN DEGREE, THRUST ACCEL. IN KM/S2)

     P=       0.17208826D+02  Y=      0.17191315D+02  T=      0.21738974D-02
     PDOT=   -0.57266765D-01  YDOT=  -0.57408044D-01  TDOT=   0.406887213D-06

     INCREMENTED FROM LAST ITERATION:

     P=      -0.21923275D-04  Y=      0.14022650D-04  T=      0.54471957D-08
     PDOT=    0.15971786D-05  YDOT=  -0.12567977D-05  TDOT=  -0.37060369D-09

   ----------------------------------------------------------------------

   PROPAGATED STATE AT BURNOUT USING NEW THRUST:

              -5914.9859002          3102.3833001           832.4139201
               -3.6560694142         -5.9224373907         -3.5676069895

   DIFFERENCE BETWEEN TARGET AND PROPAGATED STATE:

                  0.0000002            -0.0000001            -0.0000001
                  0.0000000142         -0.0000000093         -0.0000000105

   (MISS DISTANCE = 0.24399D-06 --- MISS VELOCITY = 0.19964D-07)

   CONVERGENCE TEST RESULT:              1
   (0=FAILED, 1=PASSED)
```

Figure H-77. Sample of THMODEL Program Output to User at the End of Each Iteration (1 of 2)

```
                                   GTDS  THMODEL  PROGRAM
                     ORBIT GENERATOR REPORT (ITERATION #  5 )                                                   PAGE    23
                                          INDEX - ORBIT GENERATOR REPORT (ITERATION #  5 )

            SATELLITE NAME               SAMPLE-1
            SATELLITE NUMBER               7654321
            RUN REFERENCE DATE           SEPT 12, 1986     0 HRS     0 MINS      0.00000 SECONDS
            RUN EPOCH DATE               SEPT 12, 1986    14 HRS    30 MINS      0.00000 SECONDS
            RUN FINAL TIME               SEPT 12, 1986    14 HRS    31 MINS      0.00000 SECONDS
            TOTAL TIME OF FLIGHT           0 DAYS      0 HRS     1 MINS    0.00000 SECONDS
            CAUSE OF TERMINATION         SPECIFIED TIME OF FLIGHT REACHED

                                            ***END  CONDITIONS***
CENTRAL BODY IS EARTH    (INERTIAL SYSTM)                                       TRUE OF DATE
X     -0.59149859001658508D+04           Y      0.31023833001099230D+04          Z      0.83241392014121360D+03
DX    -0.36560694141906480D+01           DY    -0.59224373907107130D+01          DZ    -0.35676069894699480D+01

SMA    0.69600924784058070D+04           ECC    0.33365290542807390D-01          INC    0.28246384738537780D+02
LAN    0.34573676780722850D+03           AP     0.15529918837927650D+03          MA     0.89335408337238170D+01
EA     0.92405186019486810D+01           P      0.96312384951753570D+02          SLR    0.69523442068683830D+04
PR     0.67278669706589890D+04           APR    0.71923179861526230D+04          PN     0.34972697065898960D+03
APN    0.81417798615262380D+03           C3    -0.28634722975067320D+02          TA     0.95527233358830720D+01

RA     0.15232319336367450D+03           DEC    0.71040072301655190D+01          VPA    0.89692854160812390D+02
AZ     0.11740994553236510D+03           RMAG   0.67308805719910530D+04          VMAG   0.78211206255614980D+01

                                          ***INITIAL  CONDITIONS***
CENTRAL BODY IS EARTH    (INERTIAL SYSTM)                                       TRUE OF EPOCH
X     -0.56846304000000000D+04           Y      0.34474253000000000D+04          Z      0.10436586000000000D+04
DX    -0.40177380000000000D+01           DY    -0.55761939000000000D+01          DZ    -0.34729043000000000D+01

SMA    0.67373563690746050D+04           ECC    0.11473253471006010D-02          INC    0.28482695671552050D+02
LAN    0.34558340820247530D+03           AP     0.16942961104040470D+03          MA     0.35161233858898580D+03
EA     0.35160273865204820D+03           P      0.91726305534947310D+02          SLR    0.67373475003180080D+04
PR     0.67296264293399220D+04           APR    0.67450863088076680D+04          PN     0.35148642933992230D+03
APN    0.36694630880766820D+03           C3    -0.29581383124520460D+02          TA     0.35159313326070090D+03

RA     0.14876542145641590D+03           DEC    0.89215677190637250D+01          VPA    0.90009599943257890D+02
AZ     0.11716122961647690D+03           RMAG   0.67297092995937200D+04          VMAG   0.77004689028655710D+01

                                         *** SECTIONING SUMMARY ***
                      NUMBER OF SECTIONS SCHEDULED =      1
                      NUMBER OF SECTIONS COMPLETED =      1
SECTION CENTRAL BODY    TIME OF CROSSING              TIME INTO FLIGHT         CAUSE OF CROSSING
                                H   M     S              H   M    S
   1       EARTH        SEPT 12  14  31   0.000          0   0  60.000      SPECIFIED TIME OF FLIGHT REACHED

                                      *** FILE GENERATION SUMMARY ***

                      NO FILES HAVE BEEN GENERATED

                                    *** NUMBER OF GTDS ERRORS ENCOUNTERED=      0**

                                       UNITS FOR INFORMATION
          DISTANCES ARE IN KILOMETERS                   ANGLES       ARE IN DEGREES
          RATES     ARE IN KM/SEC                       TIME(PERIOD) IS IN HOURS
```

Figure H-77. Sample of THMODEL Program Output to User at the End of Each Iteration (2 of 2)

```
***************************************************************************************
*                                                                                     *
*                                                                                     *
*                          THMODEL PROGRAM FINAL REPORT                               *
*                                                                                     *
*                      (RUN TIME:  87/ 7/21/13/21/55.499)                             *
*                                                                                     *
*                                                                                     *
***************************************************************************************


   1. DATA FROM INPUT

      SATELLITE ACRONYM:                     SAMPLE-1
      SATELLITE ID:                          7654321
      MANEUVER NUMBER:                       1
      TIME AT IGNITION:                      860912143000.000
      TIME AT BURNOUT:                       860912143100.000
      MASS OF VEHICLE AT IGNITION:           92000.0000 KGS
      MASS OF VEHICLE AT BURNOUT:            91000.0000 KGS
      MASS FLOW RATE:                          -16.66666666 KG/SEC
      STEP SIZE:                                 1.00000000 SEC
      STATE VECTOR AT IGNITION:

        X (KM): -.5684630400D+04       XDOT (KM/S): -.4017738000D+01
        Y (KM): 0.3447425300D+04       YDOT (KM/S): -.5576193900D+01
        Z (KM): 0.1043658600D+04       ZDOT (KM/S): -.3472904300D+01

      STATE VECTOR AT BURNOUT:

        X (KM): -.5914985900D+04       XDOT (KM/S): -.3656069400D+01
        Y (KM): 0.3102383300D+04       YDOT (KM/S): -.5922437400D+01
        Z (KM): 0.8324139200D+03       ZDOT (KM/S): -.3567607000D+01

   ------------------------------------------------------------------------------

   2. ESTIMATED THRUST COEFFICIENTS (FROM ITERATION #    5)

        PITCH (DEGREE): 0.1720882634D+02    PITCH RATE  (DEG/S): -.5726676544D-01
        YAW   (DEGREE): 0.1719131550D+02    YAW RATE    (DEG/S): -.5740804355D-01
        THRUST (KM/S2): 0.2173897357D-02    THRUST.RATE (KM/S3): 0.4068721274D-06

   ------------------------------------------------------------------------------

   3. PROPAGATED STATE VECTOR AT BURNOUT FROM IGNITION
        USING ESTIMATED THRUST MODEL COEFFICIENTS:

        X (KM): -.5914985900D+04       XDOT (KM/S): -.3656069414D+01
        Y (KM): 0.3102383300D+04       YDOT (KM/S): -.5922437391D+01
        Z (KM): 0.8324139201D+03       ZDOT (KM/S): -.3567606989D+01

   4. DIFFERENCE BETWEEN TARGET AND PROPAGATED VECTORS AT BURNOUT:

        X (KM): 0.1658499968D-06       XDOT (KM/S): 0.1419064755D-07
        Y (KM): -.1099234623D-06       YDOT (KM/S): -.9289287339D-08
        Z (KM): -.1412135475D-06       ZDOT (KM/S): -.1053005150D-07

      (MISS DISTANCE (KM) = .2439890D-06 --- MISS VELOCITY (KM/S) = .1996365D-07)

   5. CONVERGENCE TEST RESULT:         PASSED

   6. TOTAL NUMBER OF ITERATIONS AT THE END OF PROCESSING:      5

      ITERATION OF BEST ESTIMATE:                               5

      ITERATION OUTPUT TO FSF:                                  5

****************************** END OF THMODEL PROGRAM ******************************
```

Figure H-78. Sample of THMODEL Program Final Report

APPENDIX I - USER'S GUIDE FOR THE GTDS RESIDUALS PRINTER PLOT PROGRAM

The GTDS Residuals Printer Plot Program (GRPPP) provides 132-column printer plots of the observation residuals produced during a single GTDS DC Program run. This appendix describes the user input required for executing this GTDS-related program, as well as the options available to the user. The load module, called 'PLOT,' is stored with the GTDS load module.

Input parameters to the GRPPP are via NAMELIST 'PLTOP,' which is described later in this appendix. Also, input to the program is a Residuals Plot Data File, which is FRN 62 in both programs and is created by GTDS whenever the user places a '7' in columns 15 to 17 of the SELOUT keyword card in a GTDS DC run (SOR option).

Output of the GRPPP consists only of printer plots, the contents of which are controlled by both the residuals in the file and the variables in NAMELIST PLTOP.

The plots produced are X-Y plots. The horizontal (X) axis is for time (HH.MM.SS) and the vertical axis (Y) is for the residuals, labeled as the observation type and its corresponding unit. The plot scale for the Y-axis can be manually adjusted. The default for the Y-axis is 3-sigma (of standard deviations) on either side of the unedited residuals mean. If the residuals mean and the standard deviation are not available in the data file, the program will search the unedited residuals and decide the maximum and minimum scale for the Y-axis. The maximum number of data points in a single plot is 100.

To guide the user in making selections in NAMELIST input, the user should examine the 'Summary of GTDS Residual Plot File,' which is created at the end of the GTDS run that produced the Residual Plot Data File, and summarizes the batches contained in the file that are available for plotting. A sample summary is shown in Figure I-1.

Figure I-2 is sample JCL for executing the GRPPP.

The remainder of this appendix identifies the available NAMELIST selections and their use.

All selections are made via NAMELIST 'PLTOP.' The user must first choose one of five possible selections (which are exclusive) (see Figure I-3). The following describe the selection options and their limitations:

- Plot all batches (ALL = T)

  This option allows the user to generate residual plots for all individual batches. The variables involved to invoke this option are shown in Figure I-4. The plots are generated batch by batch.

- Selected by types (ALL = F, LTYPE = T, etc.)

  This option allows the user to generate residual plots for up to four selected measurement types. GTDS measurement type numbers are used to select types. The variables involved to invoke this option are shown in Figure I-5. The plots are generated batch by batch for those selected measurement types.

- Selected by sets (ALL = F, LSET = T, etc.)

  This option allows the user to generate residual plots for up to four selected sets. The difference between 'set' and 'batch' is that in the GTDS RESIDUAL PLOT FILE two sets belong to the same batch.

***** SUMMARY OF GTDS RESIDUAL PLOT FILE*****

***** TOTAL SET = 5 ARE CREATED IN GTDS RESIDUALS PLOT FILE *****

SET	BATCH	SAT. ID.	SAT. NO.	TRKER	ANTENNA	TYPE 1	TYPE 2	TYPE 3	TYPE 4	START TIME	END TIME
1	1	LANDSAT5	8207201	VDB3	SRE	14(UX30)	15(UY30)	13(URAN)	10(URDF)	881214172927.60	881214173132.40
2	2	LANDSAT5	8207201	VDB3	SRE	14(UX30)	15(UY30)	13(URAN)	10(URDF)	881214173133.40	881214173337.40
3	3	LANDSAT5	8207201	VDB3	SRE	14(UX30)	15(UY30)	13(URAN)	10(URDF)	881214173338.40	881214173542.40
4	4	LANDSAT5	8207201	VDB3	SRE	14(UX30)	15(UY30)	13(URAN)	10(URDF)	881214173543.40	881214173747.40
5	5	LANDSAT5	8207201	VDB3	SRE	14(UX30)	15(UY30)	13(URAN)	10(URDF)	881214173748.40	881214173900.40

Figure I-1. Summary of the GTDS Residuals Plot File

```
//ZBIYWIYP JOB (CGTDM,SWDEV,FFW),'FT62-PLT',MSGLEVEL=(2,0),
//   MSGCLASS=X,TIME=(0,10),CLASS=V,NOTIFY=ZBIYW
/*ROUTE PRINT F2MVS.PRTGT
//*THISDATE BOX-FFW
//* ******************************
//* * GTDS RESIDUAL PLOT PROGRAM *
//* ******************************
// EXEC PGM=PLOT,COND=(4,LT),REGION=2000K
//STEPLIB DD DSN=DVTST.GTDS.LOAD,DISP=SHR
//GO.FT05F001 DD *
&PLTOP
  ALL=.FALSE., LTRKR=.TRUE., NTRKR=3, TRKER='GDS8','GDS8','WHSK',
&END
//GO.FT06F001 DD SYSOUT=*
//GO.FT62F001 DD DSN=ZBIYW.FT62.NBS7.DATA,DISP=SHR
//
```

Figure I-2. Sample JCL to Run the GTDS Residuals Plot Program

Name	Format	Selection	Note
ALL	I*1 (T or F)	Universal	= T, to plot all sets = F, for other options
ANG1MN	R*8	Universal	Manual minimum for angle 1 default = -0.2DO (deg)
ANG1MX	R*8	Universal	Manual maximum for angle 1 default = 0.3DO (deg)
ANG2MN	R*8	Universal	Manual minimum for angle 2 default = -0.3DO (deg)
ANG2MX	R*8	Universal	Manual maximum for angle 2 default = 0.4DO (deg)
DPLRMN	R*8	Universal	Manual miminum for Doppler default = -500.DO (Hz)
DPLRMX	R*8	Universal	Manual maximum for Doppler default = 1000.DO (Hz)
IDATYP(4)	I*4	Type, time	GTDS type numbers
IFRST	I*4	Time	Start set number to be plotted within timespan default = 0
KSET(4)	I*4	Set	Set ID numbers
LAST	I*4	Time	Last set number to be plotted within timespan default = 1000
LSET	I*1 (T or F)	Set	= T, to plot by sets
LTIME	I*1 (T or F)	Time	= T, to plot by timespan

Figure I-3. Summary of the Variables in the NAMELIST PLTOP (1 of 2)

Name	Format	Selection	Note
LTRKR	I*1 (T or F)	Tracker	= T, to plot by tracker
LTYPE	I*1 (T or F)	Type	= T, to plot by types
MANUAL	I*1 (T or F)	Universal	= T, to set y-scale manually
NSET	I*4	Set	How many sets to plot
NTYPE	I*4	Type, time	How many types to plot
NSIGMA	I*4	Universal	Mean + nsigma * dev: max(y) mean - nsigma * dev: min(y) default = 3
NTRKR	I*4	Tracker	How many trackers
RANGMN	R*8	Universal	Manual minimum for range default = -50.DO (m)
RANGMX	R*8	Universal	Manual maximum for range default = 50.DO (m)
RRATMN	R*8	Universal	Manual minimum for range-rate default = -50.DO (m/s)
RRATMX	R*8	Universal	Manual maximum for range-rate default = 80.DO (m/s)
TRKER(4)	C*4	Tracker, time	Tracker's acronyms
TSTART	R*8	Time	Start time of time-span default = 0.DO
TSTOP	R*8	Time	End time of timespan default = 1.D30

Figure I-3. Summary of the Variables in the NAMELIST PLTOP (2 of 2)

```
**************************************************************
*    PLOT SCALE-OPTIONS:                                     *
*                     NSIGMA     =          3                *
*                     MANUAL     =          F                *
*                     ANG1MX     =    0.30000                *
*                     ANG1MN     =   -0.20000                *
*                     ANG2MX     =    0.40000                *
*                     ANG2MN     =   -0.30000                *
*                     RANGMX     =   50.00000                *
*                     RANGMN     =  -50.00000                *
*                     RRATMX     =   80.00000                *
*                     RRATMN     =  -50.00000                *
*                     DPLRMX     = 1000.00000                *
*                     DPLRMN     = -500.00000                *
*    SELECT BY ALL OPTIONS:                                  *
*                     ALL        =          T                *
**************************************************************
```

Figure I-4. Variables in PLTOP To Plot All Batches

```
************************************************************************
*    PLOT SCALE OPTIONS:                                               *
*                         NSIGMA        =             3                *
*                         MANUAL        =             F                *
*                         ANG1MX        =       0.30000                *
*                         ANG1MN        =      -0.20000                *
*                         ANG2MX        =       0.40000                *
*                         ANG2MN        =      -0.30000                *
*                         RANGMX        =      50.00000                *
*                         RANGMN        =     -50.00000                *
*                         RRATMX        =      80.00000                *
*                         RRATMN        =     -50.00000                *
*                         DPLRMX        =    1000.00000                *
*                         DPLRMN        =    -500.00000                *
*    SELECT BY TYPE OPTIONS:                                           *
*                         ALL           =             F                *
*                         LTYPE         =             T                *
*                         NTYPE         =             4                *
*                         IDATYP 1      =            11                *
*                         IDATYP 2      =            12                *
*                         IDATYP 3      =            13                *
*                         IDATYP 4      =            10                *
************************************************************************
```

Figure I-5. Variables in PLTOP To Plot Selected Types

For example, TDRSS, range, and Doppler data are in one set, while the angle data are in another set, but they are in the same batch. The variables involved to invoke this option are shown in Figure I-6. The plots are generated batch by batch.

- Selected by trackers (ALL = F, LTRKR = T, etc.)

  This option will allow the user to generate residual plots for up to four selected trackers. The variables involved to invoke this option are shown in Figure I-7. The plots are generated batch by batch.

- Selected by timespan (ALL = F, LTIME = T, etc.)

  This option will allow the user to select a desired timespan for up to four observation types and their associated trackers. In each plot all the observations within the desired timespan and between the selected set range will be plotted for an observation type and its associated tracker. The variables involved to invoke this option are shown in Figure I-8.

```
**********************************************************************
*     PLOT SCALE OPTIONS:                                            *
*                   NSIGMA       =           3                       *
*                   MANUAL       =           F                       *
*                   ANG1MX       =     0.30000                       *
*                   ANG1MN       =    -0.20000                       *
*                   ANG2MX       =     0.40000                       *
*                   ANG2MN       =    -0.30000                       *
*                   RANGMX       =    50.00000                       *
*                   RANGMN       =   -60.00000                       *
*                   RRATMX       =    80.00000                       *
*                   RRATMN       =   -50.00000                       *
*                   DPLRMX       =  1000.00000                       *
*                   DPLRMN       =  -500.00000                       *
*     SELECT BY SET OPTIONS:                                         *
*                   ALL          =           F                       *
*                   LSET         =           T                       *
*                   NSET         =           4                       *
*                   KSET    1    =           2                       *
*                   KSET    2    =           3                       *
*                   KSET    3    =           4                       *
*                   KSET    4    =           5                       *
**********************************************************************
```

Figure I-6. Variables in PLTOP To Plot Selected Sets

```
PLOT SCALE OPTIONS:
                    NSIGMA      =          3
                    MANUAL      =          F
                    ANG1MX      =    0.30000
                    ANG1MN      =   -0.20000
                    ANG2MX      =    0.40000
                    ANG2MN      =   -0.30000
                    RANGMX      =   50.00000
                    RANGMN      =  -50.00000
                    RRATMX      =   80.00000
                    RRATMN      =  -50.00000
                    DPLRMX      = 1000.00000
                    DPLRMN      = -500.00000
SELECT BY TRACKER OPTIONS:
                    ALL         =          F
                    LTRKR       =          T
                    NTRKR       =          3
                    TRKER 1     =       MIL3
                    TRKER 2     =       GDS8
                    TRKER 3     =       WHSK
                    TRKER 4     =
```

Figure I-7. Variables in PLTOP To Plot Selected Trackers

```
PLOT SCALE OPTIONS:...
              NSIGMA         =                   3
              MANUAL         =                   F
              ANG1MX         =             0.30000
              ANG1MN         =            -0.20000
              ANG2MX         =             0.40000
              ANG2MN         =            -0.30000
              RANGMX         =            60.00000
              RANGMN         =           -50.00000
              RRATMX         =            80.00000
              RRATMN         =           -50.00000
              DPLRMX         =          1000.00000
              DPLRMN         =          -500.00000
SELECT BY TIME TYPE STATN OPTIONS:
              ALL            =                   F
              LTIME          =                   T
              TSTART         =881214172900.00
              TSTOP          =881214180000.00
              NTYPE          =                   3
              IFRST          =                   2
              LAST           =                   4
       IDATYP 1   =   13     TRKER  1   =     VDB3
       IDATYP 2   =   14     TRKER  2   =     VDB3
       IDATYP 3   =   16     TRKER  3   =     VDB3
       IDATYP 4   =    0     TRKER  4   =
```

Figure I-8. Variables in PLTOP To Plot Within Timespan

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